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MOTOR CONTROL IN STEEL MILLS.

The meeting of the American Institute of Electrical Engineers held at Pittsburgh last week was devoted to the applications of electric motors in the steel mill and foundry and was very successful in bringing out a lengthy discussion of this subject which is reported elsewhere in this issue. The principal topic for discussion was the method of control and this proved to be sufficient in scope to occupy four half-day sessions. These sessions were concerned respectively with control in the foundry, direct-current control in the steel mill, direct-current hoisting, and alternating-current control. Naturally enough, the discussion wandered somewhat from the specified topics, but a great deal of valuable opinion, based upon operating experience, was elicited.

Two points upon which perhaps most emphasis was laid were the necessity for safe and sure operation, and freedom from breakdowns. The former consideration was brought up in connection with foundry operation, while the latter applies especially to the steel mill. When a bloom once leaves the furnace, the necessity for continuous progress through the mill is fundamental if efficiency of operation is to be achieved. Hence reliability and continuity of operation are of greater importance than economy of energy or fine accuracy of control. On the other hand, accuracy of control is a fundamental requisite for the crane hoist in the foundry and the adoption of the electric motor for this purpose is dependent upon this accuracy and the possibility of driving at low speeds. If electrical equipment is designed with these requirements in mind there is no reason why it should not be universally adopted for this purpose.

The greater flexibility of direct-current control seems to commend it generally for hoisting operations, but where only alternating current is available it seems quite possible to ensure satisfactory operation by careful design. There is a general consensus of opinion that dynamic braking is superior and more satisfactory in every way than mechanical braking, and it is coming into very general use. Provision for mechanical braking is nevertheless essential to provide against failure of current supply and consequent loss of excitation of the field.

That automatic magnetic control is superior to manual control is generally conceded. Not only is time saved by having the various steps of control follow each other at the earliest moment, but there is an elimination of mistakes upon the operator's part and

less hard usage of the equipment. While the initial cost of such control adds to the original investment involved, this is more than made up by its advantages. There is less liability of interruptions, and a greater number of operations can be controlled by one man. Where series contactors are used, there is the possibility under overload conditions that the relay may not operate, owing to the fact that the current continues in excess of the operating value. It is permanently locked out by the excessive current. While this may at times be inconvenient, it is, after all, a protection to the apparatus which should not be condemned.

As to the relative merits of air-break contactors and oil switches, there seems to be a difference of opinion, some operators favoring one and some the other. As a matter of fact, both have their advantages and a selection must depend upon the conditions to be met in any individual installation. Since arcing under oil results in carbonization, it may be stated that air-break contacts are to be preferred where the operations are very frequently repeated and the deterioration of the oil would consequently be rapid. The holding of arcs on air breaks, however, has frequently caused trouble, and generalization on this point may not be safe. A study of local conditions is usually advisable in determining a point of this kind, and experience in the field is the most reliable guide in designing an installation.

THE SMALL MOTOR.

The perfection of the fractional-horsepower motor is a development of recent years. The varied applications of this type have created a demand which has made it worth while to work out both mechanical and electrical elements of design with the same care which is devoted to large machines. The result is a reliable motor having a reasonable efficiency and suited to a large variety of applications. Not only direct-current but single-phase motors of satisfactory performance are now available, and it is to the latter, no doubt, that the popularity of small-motor applications is largely due, since alternating-current distribution has become also universal except for the business centers of large cities.

The development and characteristics of these small motors were well brought out at the Cleveland meeting of the American Institute of Electrical Engineers last month in the paper by Mr. Bernard Lester. This paper showed what has been accomplished in this country with the fractional-horsepower motor, and how it has been applied. It is well to remember in this connection that this development is purely American and that the European manufacturer has been entirely distanced in this particular development. The European designs show no such selection and no such care in working out the details of construction that are characteristic of the American product. This condition redounds not only to the benefit of the manufacturer himself but to all elements in the industry and particularly to the central station. The availability of a satisfactory motor of such small capacity does much to popularize electric drive, and a multiplicity of small loads soon mounts to a respectable consumption of electrical energy, with a diversity-factor superior to that accompanying larger units of load.

THREE-COLOR ILLUMINATION.

Recent progress in the development of red, green and blue-violet filters which will retain their coloring in their original purity without disintegration during the life of the tungsten lamp marks a real advance of science in a field of great industrial usefulness. The problems of color matching are perhaps of incidental interest to the engineer outside the realm of painting, and the possibilities of color synthesis in theatrical work are of more concern to the stage electrician than to a member of the engineering profession; and yet the culmination of a long research in the production of pure primary colors, from which, with white light as a diluting material, a wonderful range of blends and tints may be formed by the simple means of varying the flow of current through a few lamps, challenges admiration. The solution of the problem, resulting from the laborious study of about 1,500 dyes by Mr. Munroe Rhodes Pevear, of Boston, Mass., gives another means of attaining scientific precision in fields of industry hitherto a good deal handicapped from the lack of such standards. This study was the subject of a paper at the February meeting of the New England Section of the Illuminating Engineering Society.

Mr. Pevear has found three dyes which accurately represent the three primary colors, red, green and violet. These dyes are, moreover, stable with respect to both time and temperature. Lamps dipped with these dyes not only retain their color values, but have the good mechanical quality of not peeling off in a few weeks. Their life appears to be as great as that of a tungsten lamp. The latter quality will appeal to the stage electrician, and the color values will permit a more accurate synthesis of color than has hitherto been possible, or, at least, convenient. It is stated that any spectrum color, and purples as well, can be secured by blending the light which has passed through these color screens. The use of undipped lamps, in addition, permits any desired tint to be secured.

The production of artificial daylight, so necessary in color matching of textiles and elsewhere, appears to have been made more easy by Mr. Pevear's work, and, no doubt, many applications will be found for the color filters which he has been so successful in producing.

Curiosity is naturally aroused as to the composition of the dyes which so perfectly fulfil the desired function, but on this point we are not informed.

QUALITY IN ELECTRICAL CONSTRUCTION.

The general public has little ability to judge of quality of work or material in an electrical installation. Unless his judgment be guided by expert advice, the average owner of a building will be satisfied with an equipment which enables the lamps to burn or the motors to run, and whose visible parts have a good finish. Consequently, when contracts are being considered, his decision is likely to be principally influenced by price.

It is necessary for the electrical contractor who wishes to do first-class work, consequently, to talk quality to the prospective customer, and to acquaint him with the possible differences in the character of the electrical work which is to be installed. The proper time to talk quality is before a bid is made; in fact, before the specifications are drawn up, if this be possible. The contractor should insist upon plans and specifications which will indicate clearly the character of work and the quality of material which is desired. Otherwise the man who intends to do high-grade work with good material will find himself hopelessly out of the running with the unscrupulous contractor. Even where specifications are clear, it is highly desirable that reputable contractors should refuse to bid against irresponsible ones, since the latter will almost always bid upon the basis of skimping the job and getting away with it.

In the long run, a contractor with a reputation for low prices is not likely to prosper. His dealings are principally with those who have no appreciation of good work, and who let their contracts on the basis of price alone. It is necessary for him to use inferior materials and a low grade of workmanship, since he must compete with the worst element among his competitors. He finally gains a reputation for poor work, and this makes it almost impossible for him to afterwards get any job at a good price. On the other hand, the contractor who achieves a reputation for good work will be sought by people who recognize this fact and are willing to pay a fair price for a high-grade installation.

There are difficulties, of course, in making a stand for first-class work and refusing to do any other kind. Many contracts will be lost, and the path may not be an easy one while a reputation is being achieved. Earnest effort will be required in perpetually talking quality and convincing customers that the best, or, at least, good material and workmanship are the cheapest in the long run, even where the difference is not immediately discernible in the completed job. The contractor must not only talk quality, but he must think it, and put it into his work. He must educate his customers to want it and to insist upon getting it.

The difficulties are lessened when the high-grade contractors in any community co-operate in spreading the gospel of quality and in refusing to bid on jobs where price is the only consideration.

THE VALUE OF A SHOW ROOM.

That the presentation to the eye of an electrical device will call attention to its existence and suggest its value to a potential customer is generally recognized. The show window possesses this element of value to the electrical dealer and the central station, just as it does to every other type of merchant. A moving display is many times more valuable in compelling this attention and stimulating not only the curiosity but the desire of the prospective user of a device. For this reason it is always worth while to apply current to a fan, washing machine or other current-consuming device which is on display. Motion always attracts the eye.

The function of the show window, like the printed advertisement, is to attract attention and elicit interest. But it should not be expected to sell goods. Unless backed up by salesmanship behind the counter it cannot be expected to develop much business. The mistake is frequently made of leaving the show room in charge of some inexperienced person lacking knowledge of the goods and ability to develop curiosity and interest into the desire which results in purchase. The value of a show room depends in part upon a suitable and tasteful display of wares, but mainly upon its being attended by a tactful, courteous and alert salesman who is familiar with the wares displayed, and has a sufficient general acquaintance with matters electrical to talk intelligently upon the subject.

Moreover, he should realize that it is of greater importance to supply the customer with a device which will meet his requirements and prove satisfactory in service than it is to merely consummate a sale.

AN INTERNATIONAL ELECTRICAL WEEK.

The general plans for an Electrical Prosperity Week, to be held during the first week in December, have already been announced. The Society for Electrical Development has this week made an appropriation of $50,000, which insures the carrying out of plans which will make this event a significant one and focus the attention of the entire country upon the possibilities of electrical applications.

It has been proposed to make this movement international in character by instituting a campaign of the same nature in England. The matter has been put before the Development Committee of the Incorporated Municipal Electrical Association, and it is possible that propaganda work will be carried on in that country during the same week that signalizes electrical development in America. While war conditions may not make the proposal timely in Englan at this date, there is a possibility that the war may be terminated before December, and also that it may be found feasible to carry it out in spite of the war. The combination of electrical efforts to emphasize this week simultaneously in both countries would no doubt bring greater results than if the movement remained merely a national affair.

Electrical Exports for February.

The following data on the electrical exports of the United States for February are from the official government report on the foreign commerce of that month issued by the Bureau of Foreign and Domestic Commerce.

The total value of the electrical shipments in February was about 12 per cent below that of the corresponding month of a year ago. It was somewhat below that of last January, but greater than the figures of the last seven months of 1914. In the four classes for which numbers of articles shipped are given, there were exported in February: Electric fans, 723; arc lamps, 390; carbon-filament lamps, 90,278; metal-filament lamps, 233,455.

In the following table are given the detailed figures for the various electrical classes reported, with corresponding figures for February, 1914:

Articles	Feb. 1915.	Feb. 1914.
Batteries	$109,214	$ 54,488
Dynamos or generators	127,565	206,392
Fans	10,206	36,985
Insulated wire and cable	95,641	153,607
Interior wiring supplies, etc. (including fixtures)	67,648	48,954
Lamps—		
Arc	8,031	6,918
Carbon-filament	9,862	14,255
Metal-filament	51,373	10,857
Meters and other measuring instruments	22,807	.....
Motors	325,224	241,488
Static transformers	46,646	142,888
Telegraph instruments (including wireless apparatus)	6,589	6,874
Telephones	101,957	157,851
All other	700,804	848,956
Total	$1,683,567	$1,930,513

New York Electrical Show Dates.

The ninth annual New York Electrical Show will be held October 6 to 16, 1915, at the Grand Central Palace, New York City. In spite of the business depression last fall the attendance and sales at the last show were unusually satisfactory which indicates that the coming exposition, in view of returning prosperity, will establish new records for like events. Plans and contracts for space are already available and greater effort than ever before is being extended to make the show of real value to the exhibitors and the public.

Arthur Williams of the New York Edison Company is president of the show organization.

Institute Appointments.

The American Institute of Electrical Engineers has appointed a special committee on hazards from lightning, consisting of Elihu Thomson, chairman; A. E. Kennelly, Comfort A. Adams, Louis Bell, D. C. Jackson.

S. G. McMeen has been appointed a member of the Edison Medal Committee in place of H. Ward Leonard, deceased.

Convention of National Association of Manufacturers.

The twentieth annual convention of the National Association of Manufacturers will be held at the Waldorf-Astoria Hotel, New York City, May 25 and 26. There will be formal addresses on current topics by speakers of national fame. Committee reports and other subjects of vital importance will be discussed.

Full details relative to the program, banquet, speakers and other arrangements will be issued at an early date by the Committee of Arrangements. Incidental to the convention there will be an elaborate exhibition devoted to various phases of industrial education.

The usual banquet will be held in the grand ballroom of the Waldorf-Astoria Hotel on the evening of May 26. The speakers will be William H. Taft, former president of the United States, and Warren G. Harding, senator-elect from Ohio.

Electric Club Organized at Springfield.

At a meeting of 40 men in the building of the United Electric Light Company, Springfield, Mass., on April 14, an electric club was organized. The following officers were elected:

President, Kurt R. Sternberg, of Dickinson Manufacturing Company.

Secretary, L. J. Kemper.

Treasurer, Fred Rogers, Jr.

During the evening short talks were given by Walter L. Mulligan, superintendent of the United Electric Light Company, Arthur J. Newell, of Holyoke, and others. It was voted to hold the next meeting April 26 in the Highland Hotel. A dinner will be served at 8 o'clock and the meeting will follow.

Convention Trip of Chemical Engineers.

In connection with the annual convention of the American Institute of Chemical Engineers, to be held at San Francisco, August 25 to 28, a trip has been arranged to include the Grand Canyon, San Diego, Yosemite Valley, Seattle and Yellowstone Park. Visits will be made to a copper mine at Butte, smelters at Anaconda and local industries in California. The secretary is J. C. Olsen, Cooper Union, New York City.

Melting Alloys in the Electric Furnace.

The Association of Iron and Steel Electrical Engineers will hold a meeting at Pittsburgh, Pa., on May 1, at which a paper on "The Electric Furnace and the Melting of Alloys" will be presented by R. S. Wile.

New York Electrical Society Hears Early History of Telephone.

At the meeting of the New York Electrical Society, held on April 14, Thomas Augustus Watson, who was associated with Dr. Alexander Graham Bell in the invention of the telephone, gave a very interesting talk entitled, "The Birth and Babyhood of the Telephone." The meeting was attended by over 1,000 persons who listened enraptured to the romantic account of the early trials and tribulations which finally resulted, in 1876, in the transmission of human speech over a short length of wire. Mr. Watson described the construction of the early telephones and how gradual improvements in the instruments and the line have permitted a steady increase in the length of line over which sound could be transmitted. In closing his address he paid a great tribute to the engineers of the American Telephone & Telegraph Company, who have been instrumental in achieving the dream of many years by the completion of the transcontinental line a few months ago.

The New York Electrical Society on the occasion of this meeting elected to honorary membership Dr. Alexander Graham Bell, inventor of the telephone; Thomas Augustus Watson, who was associated with Dr. Bell in the early work and who made the first instrument; John Joseph Carty, chief engineer of the Bell Telephone System, to whom much credit is due for the completion of the transcontinental line; and Dr. Michael I. Pupin, whose invention of the loading coils had contributed so decidedly to the extension of long-distance telephony.

Fire Prevention Work of Underwriters' Laboratories.

The various activities of the Underwriters' Laboratories, Chicago, in fire-prevention work of both an engineering and educational character were interestingly described before the Electric Club of Chicago on April 15, by J. E. Latta. The laboratories not only inspect and test material and equipment to determine the fire and accident hazard involved in the use of such products, but every effort is made to actively assist in promulgating a "safety-first" policy.

Mr. Latta showed two reels of motion pictures illustrating the methods used by the laboratories in testing. In many instances the film showed actual demonstrations under practically service conditions, such as the subjecting of fire doors and windows to flames from a gas furnace; setting fire to refuse placed under an automatic sprinkler system, demonstrations of the ability of fire extinguishers to combat flames, etc.

Development of the Central-Station Industry in Iowa.

By H. W. Wagner.

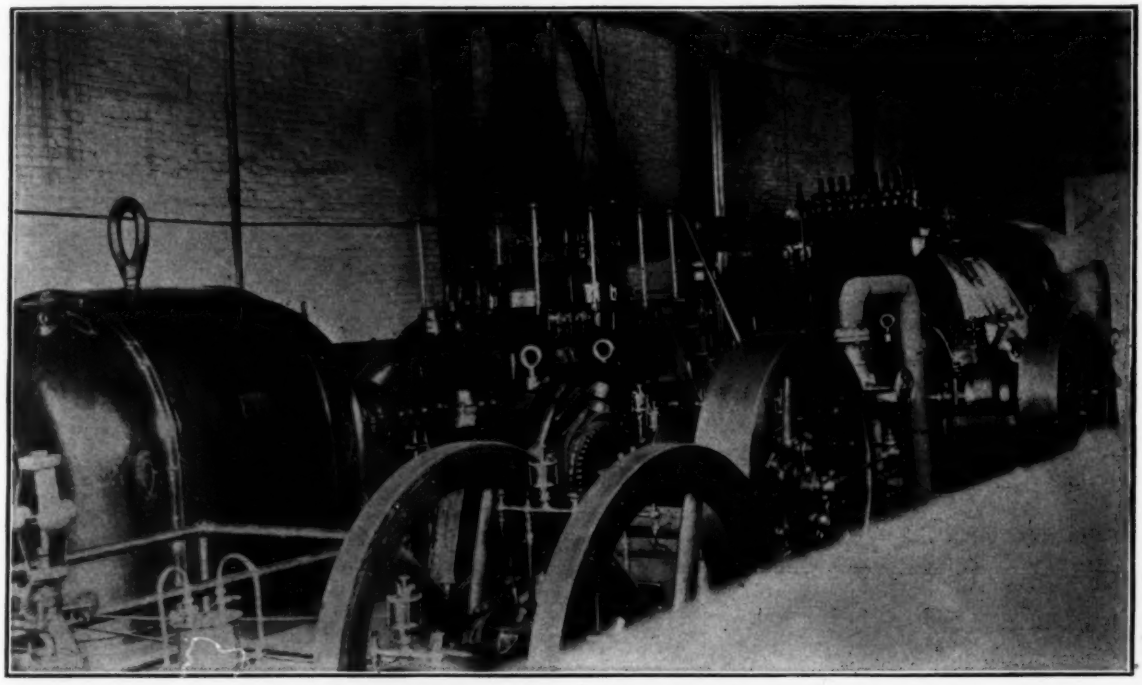
The author, who has had occasion to visit practically every electric utility of the state, comments interestingly in this article on the various phases of central-station activity, with special reference to plant operation and development.

The striking thing about electrical growth in Iowa is that most communities of 500 people or more already have or soon expect to have electric light and power at their command. While this is more or less true of other states there are certain facts contributing to the remarkable present development in this mid-west unit of territory.

Agriculture being the leading industry, the state is thickly dotted with small and wealthy but conservative towns and cities. Before the advent of a more economical prime mover and the employment of transmission lines the high cost of electric service was looked upon as prohibitive by these thrifty business men and retired farmers. But now the younger generation, especially, have awakened to the fact that they must have the glory of electric light for their homes, stores and streets. High-tension transmission, the oil engine and the tungsten lamp are their allies in this progressive undertaking. At the same time the larger cities have not been behind in the increasing adoption of new things electrical.

While the electrical survey of a district so large as a state as presented in a short article must necessarily deal in generalities, yet it offers a typical field of study and speculation full of interest and possibilities. The following is prepared largely from the experiences of the writer while serving with the Iowa Engineering Experiment Station. This experiment station is supported by the State and is located together with the State College at Ames. One of its functions is to work with and aid the central-station industry.

Perhaps the broadest undertaking of the experiment station in this connection has been a heartily indorsed cooperation with the Iowa Section of the National Electric Light Association. Austin Burt of Waterloo is standing chairman of the Facts and Factors Committee of the Iowa Section and at the 1913 convention, F. A. Fish, electrical engineer for the experiment station, was placed on the committee. Mr. Fish's offer that a representative of the station would assist in the collection of data was accepted. As a result the experiment station representative visited and corresponded with a large number of electric central stations in Iowa. He prepared the Facts and Factors report, the table of which appeared in the May 2, 1914 issue of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN. While making these visits many other data of value were gathered. Also general problems of operation were noted and the solution of these same problems in other systems was studied. A comprehensive bulletin discussing these problems and presenting classified statistics is now being prepared for free distribution to interested parties.



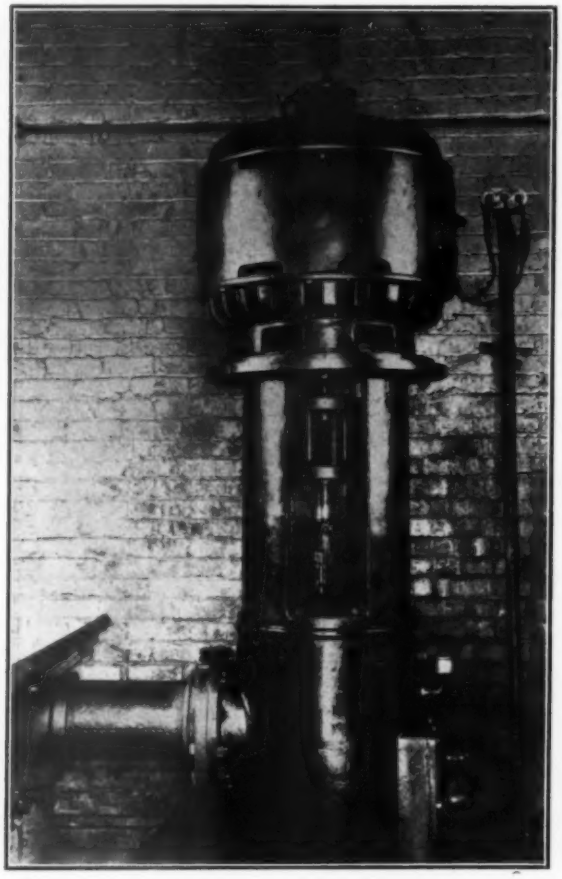
Turbine Room of the Central Iowa Light & Power Company, Fraser.

Beginning with the source of power, the subject of coal has claimed more than a little attention from the central-station engineer. Coal is mined in Iowa and is of a high heat value, but its structure and composition make it naturally unsuited for economical storage and combustion. Many stations in the northern part of the state import the greater part of their supply from Illinois. With conventional designs of furnaces and grates only from 60 per cent to 85 per cent of the boiler horsepower development possible with good Illinois screenings can be reached with a corresponding grade of Iowa coal under ordinary conditions. The latter fuel is naturally dull, slow burning and

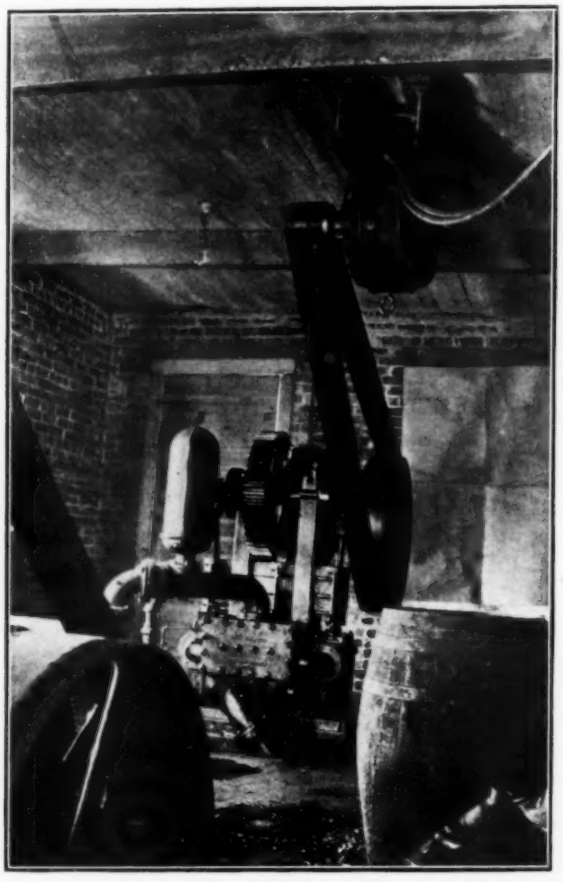
inefficient. Much of the rich gas in its high per cent of volatile combustible escapes unburnt in the form of smoke.

Only recently big advances have been made towards more efficient burning of Iowa coals. Notable impropements have been made by co-operative experiments on the part of the Green Engineering Company and the chief engineers at two plants. T. J. Richards is chief engineer at the Fraser plant of the Central Iowa Light & Power Company. In the case of one 500-horsepower Edgemoor water-tube boiler, the conform with the change in the arch. As a result more heat is reflected back upon the green coal. Combustion begins sooner and is more complete because of the higher temperature secured at the front of the grate as well as throughout the furnace. In a turbine plant using such furnaces it is found that under normal operating loads, a kilowatt-hour of electricity is produced with a consumption of from 4.5 to 6 pounds of low-grade Iowa coal.

Prices of both Iowa and Illinois screenings usually run from $0.75 to



Propeller Pump Driven by 30-Horsepower Motor.



Triplex Pump Driven by 15-Horsepower Motor.

maximum capacity possible to develop with Saylor steam coal was reported as raised from 60 per cent to over 200 per cent of the boiler rating. T. E. Rust is chief engineer of the Waterloo plant of the Waterloo, Cedar Falls & Northern (Electric) Railway Company. In this plant, the per cent of rating possible to develop with Oskaloosa steam coal was reported as raised from 70 per cent to 150 per cent by increasing the ratio of grate area to heating surface, and by modifying the furnace design. In both plants mentioned the ignition arch over the chain grate was inclined so as to make the rear end a couple of feet higher than the front end. The bridge wall was also modified to

$1.25 per ton at the mine. At certain points in the state, freight on a ton of Iowa coal is in the neighborhood of $1.00 when it is $2.00 on Illinois coal. The saving effected by using fuel from the home state is quite evident, when nearby equal efficiencies and capacities can be attained with both fuels. A number of the smaller stations equipped with hand-fired furnaces use mine run and lump coals, costing from $0.50 to $1.00 more per ton. Coal costs throughout the state vary from 5 cents to 3 cents per switchboard kilowatt-hour.

The simple Corliss engine is the most common type of prime mover and ranges in size from 60 to 400 horsepower. High-speed, simple, single-valve, automatic engines have been quite plentiful, but are going out of use since their low economy has become better known. Compound engines and multiple-valve automatic engines are coming into moderate-sized stations. Turbines lead by far in the aggregate power of steam prime movers. Their total rating is more than that of all steam reciprocating engines.

The oil engine is making big inroads as an economical producer of current in towns of from 500 to 1,000 population where transmission energy cannot be secured. Some of the first ones installed, however, broke down under operation. They may not have had skillful enough attendance, but the fact remains that at least seven were replaced by other power after an average service of about two and a half years. Worn cylinders, pistons and bearings, and broken crank shafts were the main sources of trouble. Recent designs appear to prove more satisfactory.

Oil-engine installations of from 18 to 330 horsepower have been tried in about 40 different electric central stations in Iowa. The aggregate horsepower is over 2,500. Practically all have been of the moderate and low-pressure types. Diesel engines are now being placed in

two stations. A number of tests by the experiment station show fuel costs to vary between one cent and three cents per kilowatt-hour under normal loads. At the present writing prices of fuel oils are down and result in a reduction of about 25 per cent on the above costs.

Iowa's water powers probably do not generate over five per cent of the electrical energy used in the state. Low heads, large investments necessary, and uneven stream flows have prevented any great total of development within the borders of the state. Aside from the big station at Keokuk, there is practically no hydroelectric plant in the state which is not aided by steam at one or all seasons of the year. The United States Census data show the total horsepower of water wheels used to generate electricity as 2,399 in 1902; 3,833 in 1907; and 7,029 in 1912. About 95 per cent of the power generated at Keokuk is consumed outside of Iowa. The Northern Iowa Power Company's plant on the Des Moines River at Humboldt is a noteworthy example of modern hydroelectric construction. It contains three 2,300-volt, 60-cycle, three-phase, 175-kilowatt generators, each direct-connected to a double horizontal water wheel. Water flows down a canal from upstream and is delivered at a head of 17 feet. Current is transmitted at 23,000 volts to five outside towns within a radius of 35 miles. Other towns are to be connected in the near future. Abnormal flow conditions have made it necessary to shut down the water wheels and to use steam during about 15 per cent of the year.

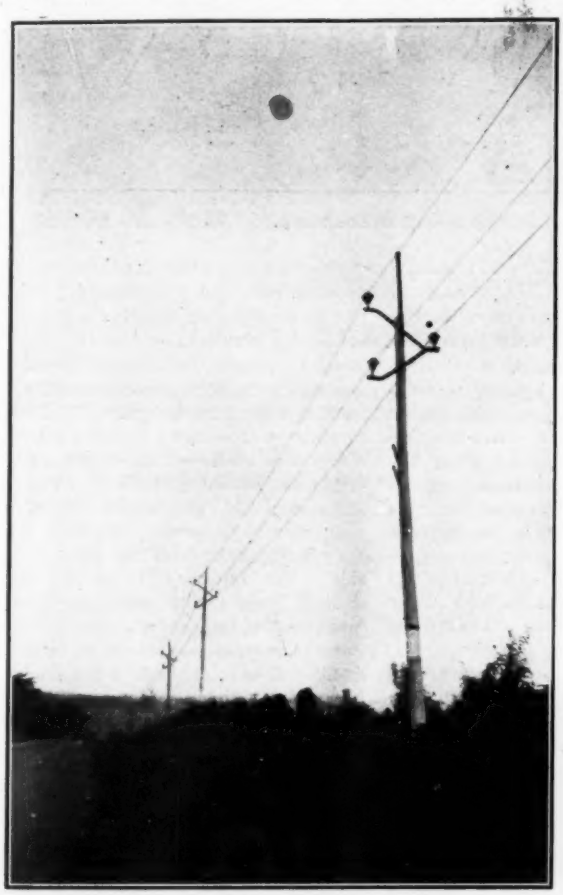
Direct-current generators are now seldom found serving towns of over 2,000 population. New ones are not purchased as a rule for towns having more than 1,000 population. Most alternators are of two or three phases with standard voltages of 1,100-1,200 and 2,200-2,400. Some engineers favor two-phase generation because of the better voltage balance secured. Two-phase energy is transformed to three-phase by the Scott system when transmitted across country.

Sixty-cycle generators are employed unless the primary requirement of current is for electric railway work. The plant located at Fraser is soon to have 13,500 kilowatts in 25-cycle turboalternators. Part of its power operates electric trains on the Ft. Dodge, Des Moines & Southern Railroad, but a goodly share goes to Ft. Dodge and a number of smaller places for light and power. Keokuk, Ft. Madison and Burlington are all served by 11,000-volt, 25-cycle lines from the generator buses in the hydroelectric plant of the Mississippi River Power Company at Keokuk.

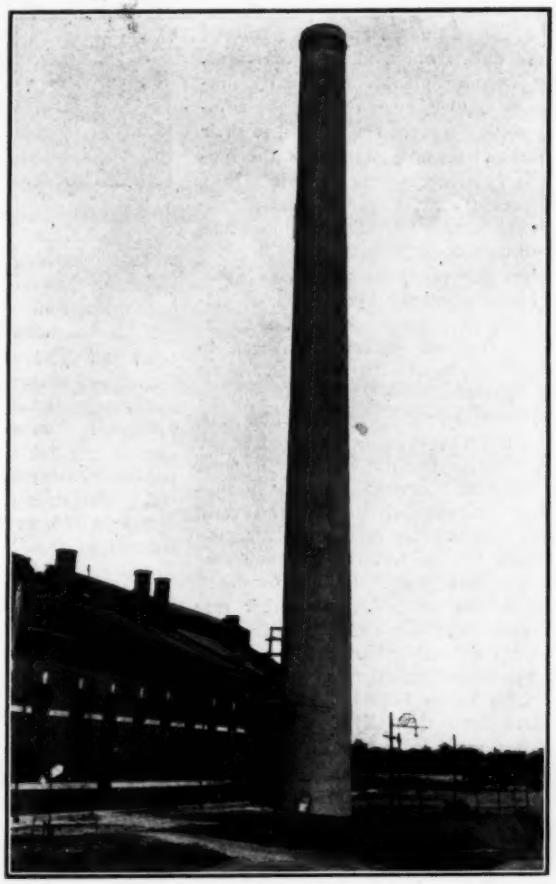
Some objections have been raised to 25-cycle lighting service, especially by persons accustomed to doing close work by lamps fed by 60-cycle current. Carbon lamps have been resorted to in a few places in order to reduce the visible flicker.

Few towns of over 1,500 population are without day current now. Even many smaller ones use a storage battery or run the generator one or two half days per week. The electric flatiron has been the big factor in developing day load in such places. Cooking and heating appliances as well as small shop motors have added to the progress. In fact, a number of small stations are likely to soon find their peak loads coming in the day time in this era of high-efficiency lamps.

Manufacturing in Iowa is growing more rapidly than many suspect. Perhaps the largest single industrial load carried by a central station is that of the Quaker Oats factory in Cedar Rapids, where a 4,000-horsepower load is



Section of Iowa Transmission Line.



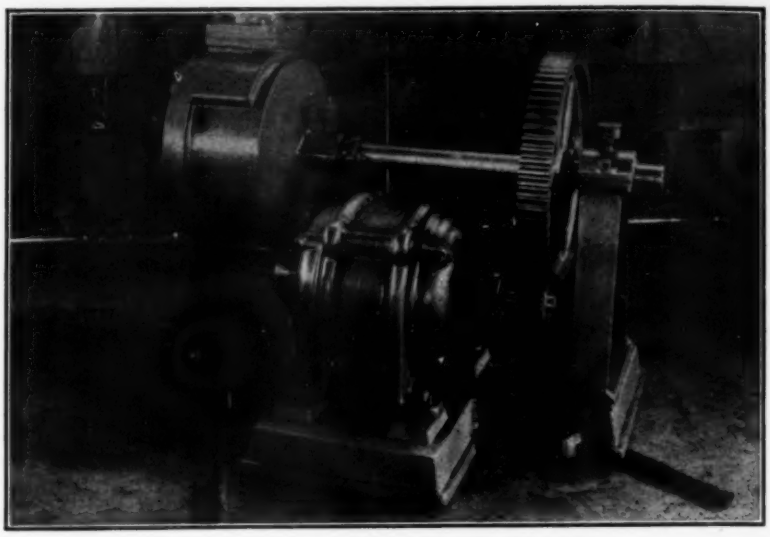
Concrete Stack at College Plant.

connected to wires from the Iowa Railway & Light Company's station. The situation is reversed at Armstrong, a town of between 700 and 800 population. A 75-kilovolt-ampere generating unit is located in a concrete tile factory and supplies not only the factory, but also the town with energy for light and power.

A fairly common central-station load is city water pumping, although this branch of the business is still open to development in many places. The experiment station has made some tests to determine the efficiency of electrically operated pumps and has gathered related data from a number of towns. The pumping plants are usually municipally owned, even though the company selling current may attend to their operation. Remote control of the motors is seldom resorted to unless they are located some distance from a convenient center. The most common motor voltage employed is 220.

Rates for pumping are based upon the kilowatt-hour or upon the 1,000 gallons pumped, more often the latter. Rates per 1,000 gallons from well to mains vary from 4 to 15 cents. Most rates, however, come within the limits of 5 cents and 10 cents. Revenue realized on energy actually delivered to the motor varies from 2 cents to 8 cents per kilowatt-hour. One company supplying transmission current for several towns estimates an energy consumption of from 1.75 to 2.25 kilowatt-hours at the generating switchboard for each 1,000 gallons pumped. In another case in which an air lift constitutes the first stage of a total lift of 525 feet, it requires approximately nine kilowatt-hours to pump 1,000 gallons from the well to the tower. The other extreme is represented by a 50-horsepower motor and an efficient triplex pump which pumps 1,000 gallons against a 110-foot head with a current consumption of approximately 0.5 kilowatt-hour. Thrust-propeller pumps have done well for deep-well service, but are likely to prove less efficient than the reciprocating and multiple-stage centrifugal pumps. Propeller and centrifugal pumps are direct-connected to vertical-shaft motors, while the reciprocating type is either belted or geared to the motor.

Many farmers are served from country lines, but such connections when taken from main transmission lines afford a possible source of trouble, especially if the line voltage is above 6,600. Some companies require the farmer to bear part or all the cost of the extra connection or of special lines. Others set a minimum rate of about $50 per year. Experience has shown that after he fully realizes the value of electric light and power, the farmer will use monthly from 15 to 25 kilowatt-hours for lighting and 25 to 50 kilowatt-hours for power.

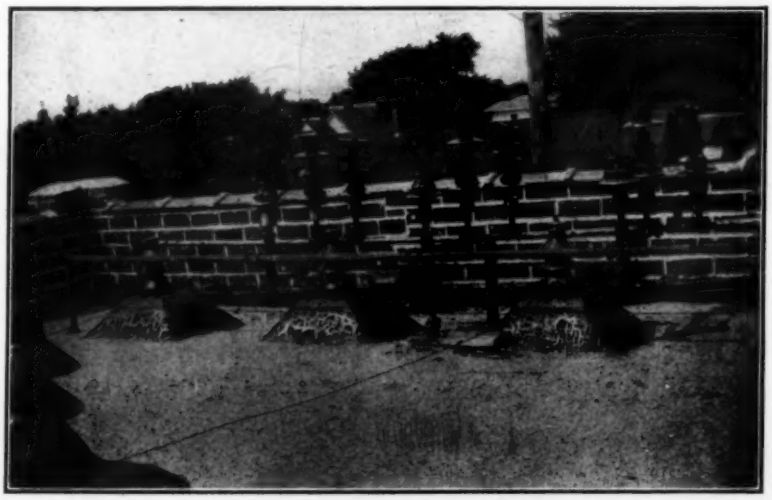


Motor Geared to Pump.

Transmission voltages from central stations to substations vary from 6,600 to 33,000. The total length of all lines would aggregate over a thousand miles and many more miles are being added each year. Three copper wires are usually strung on wood poles along the public highway or a railroad right-of-way. The sizes of wires used are from No. 6 to No. 2; No. 6 is usually considered as the lower limit, because of limiting mechanical strength. Cost of material and construction with wood poles comes between $500 and $1,000 per mile in practically every case.

Parallelisms of power circuits with telephone lines have presented difficulties in many places, but fortunately most of these differences have been settled outside of the courts. Telephone people come to understand that their line construction must be "good and modern" before they have just cause to complain of inductive interference. "Good and modern" construction is interpreted as including a metallic circuit which is found to operate fairly satisfactorily if located on the opposite side of the road from a properly built power line. But continuous conversation over a ground-return wire at the same distance is practically out of the question if the parallelism is of any considerable length. In a number of instances telephone lines have been moved bodily to the opposite side of the highway or to another route entirely, while the power company bears part of the expense. This is sometimes a financial advantage to farmers' lines, as it enables them to replace badly depreciated poles economically.

Fathering the rapid extension of transmission lines is the demand of small and moderate-sized cities and towns for substation service. This demand exists because current can be gen-



Lightning Arresters on Substation Roof.

erated in large efficient stations and transmitted to other centers more economically than it can be made in each separate town. Wholesale rates vary from 1.5 cents to .7 cents per kilowatt-hour, depending upon the advantages possessed by the generating station, upon the distance transmitted, upon the quantities used and upon how much the buyer has invested in the transmission line. Retail rates compare quite favorably with those in larger centers. Prominent generating centers not already mentioned which supply Iowa towns are Boone, Cedar Rapids, Charles City, Clarinda, Clinton, Des Moines, Leon, Lamoni, Marshalltown and Red Oak. In addition Decorah, Waukon, Postville, Lansing and Cresco in the northeastern part of the state are served by two water-power and three steam plants, all interconnected. Power generated at Omaha, Neb., and at Rock Island, Ill., is also consumed in Iowa.

A large variety of accounting systems are encountered among the central stations of Iowa. There is no public-service commission and uniform accounts are not required by law, consequently nearly every manager or auditor is left to devise his own system. In the larger companies and municipalities, records and summaries comprise a scientific whole. In one small town an elaborate system including the use of loose-leaf ledgers has been worked out by a man of limited business training, but of much electrical experience, and one who is a keen observer of modern trends. In another town a banker-manager has his accounts so arranged that he can locate quite efficiently any financial leaks that may occur. Consequently his company has been saved hundreds of dollars. But many methods of accounting are haphazard and scarcely show whether there has been a net gain or loss, or in which department the gain or loss occurred. The operation of a steam-heating, ice-making or other connected business further complicates matters. Requests of electrical societies and others for records and statistics have done much to improve accounting conditions.

As already stated, no public-service commission exists in Iowa. A bill calculated to establish such a commission lacked only two votes for passage in the Thirty-fourth Assembly of 1910-11. As presented in the Thirty-fifth Assembly the bill was hastily prepared and certain of its features were opposed.

Commercial Practice
Management, Rates, New Business

THE DEVELOPMENT OF THE SUPPLY OF ELECTRICITY IN GREAT BRITAIN.[1]

By A. H. Seabrook.

Obstacles of Progress.

In the beginning of the electrical supply industry the English Government encouraged the municipalities to acquire and finance electric supply enterprises. Rights of vetoing were granted to the municipal authorities in cases where companies applied for licenses. Parliament had granted, however, only the right to operate central stations and had not included the right to do business on a commercial basis, so that the municipalities were not allowed to extend their business by modern advertising and soliciting methods, although, strange to say, these same means were permitted and extensively used for advertising gas.

Smaller municipal electricity supply undertakings, which could not develop their business on the basis of special acts of Parliament, are not allowed to spend a penny for increasing the number of their customers.

A few unpractical politicians caused the electrical supply of London to be subdivided among a number of administrations and the latter were prohibited from working together or joining their interests in any way.

1 From *Elektrotechnische Zeitschrift*, July 9, 16 and 23, 1914. Translated and abstracted by Hugo Eisenmenger.

Rates.

The most progressive central stations are using rates based on the theory of Hopkinson ("differential rates"). The simplest form is used by a number of central stations for factories, etc., in the following way (industrial district of London): Demand charge of $20 per kilowatt per year and a kilowatt-hour charge of 1 cent per kilowatt-hour.

Power Rates for Factories.—As a rule, the standard rates just mentioned are used. The demands recorded are loads of one-fourth or one-half hour duration.

Power consumers frequently have a demand charge on the basis of the kilowatts *connected* for motors. Factories up to approximately 40 kilowatts, with normal working hours (6 a.m.—6 p.m.) are generally charged a uniform charge of two cents per kilowatt-hour, with quantity and prompt payment discounts. A few special factories with a load factor of about 90 per cent are charged under a flat demand rate. The same applies to such factories as are using very much energy, but can cut off their demand at peak load in winter. It is customary to charge a lower rate to factories which are using a great amount of energy and are located near to the central station. A few enterprises have an "off-peak rate" with a materially reduced demand charge or no demand charge at all.

Store Lighting (Commercial).—At present the rates for stores are based on the lighting demand. In future the consumption for heating will probably be in excess and a revision of the rates will become necessary.

Ordinarily the consumption is charged at a price between 12 and 6 cents per kilowatt-hour and power and heating current (separate wiring) at 2 to 4 cents per kilowatt-hour, with quantity and prompt payment discounts. Sometimes discounts according to the load-factor are granted.

The next rate according to the frequency of use is the Wright maximum demand rate: 16 to 12 cents for the first 200 to 500 hours' yearly use of maximum demand. Beyond that, 2 to 4 cents per kilowatt-hour.

The most progressive enterprises are employing the following practice:

For lighting, Hopkinson rate. The demand charge per kilowatt of maximum demand is reduced as the maximum demand increases; for instance, $75 per kilowatt up to one kilowatt, gradually sinking to $25 per kilowatt with maximum demands of 200 kilowatts.

The demand charge varies with the application to which electricity is put. A typical example is the following:

Use	Maximum demand in kilowatts	Demand charge per kilowatt	Total demand charge
Light	10	$50	$500
Power	5	10	50
Heat	20	5	100
Electromobile	10	(Off peak)	
Total	45		650

The kilowatt-hour charge is four cents straight.

Other Propositions.—For schools, offices, etc., a straight kilowatt-hour rate is offered for political reasons on account of their low load-factor (ordinarily 12 cents per kilowatt-hour, without discount).

Residential Rates.—Residential consumption probably is the biggest, as regards quantity, and is regarded by the British central-station managers as the most profitable one, since residences are requiring current for heating, cooking, etc., in an ever increasing measure, especially where proper rates are facilitating this. In addition to this, the increasing interest for public hygiene pushes this business.

(*a*) Less progressive central stations are using a straight kilowatt-hour rate for residences.

(*b*) "Semiprogressive" central stations are using the Wright demand rate. This requires separate circuits for other purposes besides lighting, and of 100 consumers only one can be made to understand this rate.

(*c*) Of all rate problems the residential rate problem is the most important and most complicated. The pure Hopkinson rate has been abandoned for residences because the maximum demand for heating and cooking does not occur at the time of the central station's peak, whereas the rates ought to encourage these latter applications.

Several prominent British central stations tried a solution on the following basis: Seventy per cent of the watts connected for *lightning* (not counting bathrooms, basements, attics, etc.) are used as basis for the demand charge at $50 to $100 per kilowatt per year. The demand for heating and cooking is not counted. The kilowatt-hour charge is one to two cents per kilowatt-hour.

Experience has shown that a residence with three kilowatts connected load for lighting (total) will have a demand of about 36 kilowatts for cooking and heating.

Under the Norwich System, the most popular system among the progressive British central stations, the demand charge is based on a percentage of the estimated "energy-value" of a residence. The latter is determined by a valuation commission (frequently by the municipal council) and is usually 80 per cent of the annual revenue from that residence.

Municipal taxes are fixed at a certain per cent of the estimated value (frequently 50 cents per dollar). Therefore the landlord of a house which rents for £100 will have to pay £40 per year as municipal taxes.

The percentage assumed for the demand charge is 10 to 15 per cent of the estimated value per year. The kilowatt-hour charge varies between 1 and 3 cents uniformly for lighting, heating and cooking.

The "Point Fives" and the Residence Rates.

The "Point Fives" is an association of those central-station managers who are using an appropriate demand charge and a kilowatt-hour charge of not over a half-penny (one cent). They have obligated themselves to do everything in their power to push the use of electricity in residences.

Load-Factor.

Under average British conditions a load-factor of 35 to 40 per cent can be achieved:

(1) By a differential rate, which encourages a liberal use of the demand.

(2) By facilitating the use of electric appliances to the public (renting, borrowing and selling of apparatus). Rent should not be based on the actual value of the apparatus, but on the time of day when it is used in relation to the peak load.

Popularization of the Use of Electricity.

Lighting.—All new houses are wired for electric light. The difficulty lies in old houses. The tenants with short contract do not want to pay the expenses for wiring and the owner will only in a few cases be willing to do the wiring at his expense. Many central stations make the wiring at their own expense and charge the consumer in various ways:

(1) By a contract for three or five years, during which time the consumer has to pay back the amount in quarterly installments. Difficulties can occur in case of a change of the tenants. Although the contract ordinarily stipulates that the original consumer has to pay the balance cash down in case he moves, this is in practice valueless. In order to provide for the possibilities of loss from this source, it is customary to add a certain percentage to the cost of wiring.

Parliament has passed an act that every gratuitous installation is property of the central station and can be neither pawned nor claimed by the landlord.

(2) The price per kilowatt-hour is raised to the consumer on account of the gratuitous installation. Same disadvantages as (1), since the new tenant may refuse to pay the higher kilowatt-hour price.

(3) A very popular method, charging a flat rate per lamp. Contract made with the *landlord*, not the tenant. The flat rate is collected from the tenant weekly. Very small residences, one to three rooms. Total about 12 cents per 25-candlepower, metal-filament lamp.

It is becoming customary to include this flat-rate charge in the rent, which is collected weekly by a representative of the landlord.

The load-factor of these residences has been found to be very high and has even reached 25 per cent. The average price per kilowatt-hour is sometimes 2 or 2.5 cents.

Power.—The power consumer usually furnishes his own wiring, but is inclined to rent or borrow a motor from the central station. The consumer pays a certain quarterly sum, which includes cost of maintenance of the motor.

Electromobiles.—Great Britain is further back in the development of electric vehicles than all other countries, for various reasons.

The Council of the Incorporated Municipal Electrical Association has formed an Electric Vehicle Committee.

Electric Cooking and Heating.—There is rarely a building to be found without gas pipes, except those built in the last few years.

The gas works could not have had such success if they had not made gratuitous installations and used prepayment meters. The income of the gas works must have been reduced greatly by the competition of electricity.

The newly founded British Gas Association is spending $100,000 to $150,000 for pushing gas heating and cooking. With practical gas efficiencies one cent per kilowatt-hour makes competition possible with gas at 62 cents per 1,000 cubic feet. As regards cooking, electricity at one cent is in a much more favorable condition than with heating.

The principal methods used in England for pushing electric heating and cooking consist in appropriate rates (Norwich rates, as described above.)

The residence load maximum, even where electric heating and cooking apparatus are installed, occurs later than the central station's peak load.

In towns, however, with chiefly residential customers this is different, and it is doubtful whether in such places a rate of one cent will be sufficient.

The central stations should be careful to make frequent inspections of the cooking apparatus, since otherwise they frequently fall into oblivion, as the cook is liable to give preference to utensils with which he or she has learned to cook. A complete electric kitchen which is permanently being demonstrated working, is indispensable for success.

Every consumer must be offered a cooking apparatus gratuitously for one whole month.

Attempts Towards Co-Operation of the British Electric Supply Companies with the Affiliated Industries.

The fact that the municipal authorities own most central stations has prevented co-operation between central stations and the industries related thereto. Private and public enterprises are not likely to co-operate.

Gradually, however, these parties have understood that in maintaining this standpoint they are working against their own interests.

The relation between the municipal central stations and the contractors has not been a pleasant one until recently. An agreement has been suggested only recently to the effect that all orders for wiring shall be turned over to the contractors, whereas the central stations have the right to sell or rent all electric appliances. There is a great chance that this agreement will become perfect and will be sanctioned by Parliament.

The gas companies, which are very influential in Great Britain, are opposed very decidedly to every agreement between the electrical business groups.

New Rate Schedule of New York Edison Company.

On May 1, the New York Edison Company will put into effect the new rate schedule recently filed with and approved by the Public Service Commission. The new rates are applicable only to the Borough of Manhattan and the Bronx.

Advertisement of New York Edison Company Announcing Rate Reduction.

General.

First 900 kilowatt-hours monthly at 8 cents per kilowatt-hour.

Next 100 kilowatt-hours monthly at 7 cents per kilowatt-hour.

Next 200 kilowatt-hours monthly at 6 cents per kilowatt-hour.

Next 300 kilowatt-hours monthly at 5 cents per kilowatt-hour.

Next 400 kilowatt-hours monthly at 4.5 cents per kilowatt-hour.

Excess over 1,900 kilowatt-hours monthly at 4.25 cents per kilowatt-hour.

Power.

First 450 kilowatt-hours monthly at 8 cents per kilowatt-hour.

Next 100 kilowatt-hours monthly at 7 cents per kilowatt-hour.

Next 1,350 kilowatt-hours monthly at 6 cents per kilowatt-hour.

Excess over 1,900 kilowatt-hours monthly at 4.25 cents per kilowatt-hour.

Wholesale.

First 75,000 kilowatt-hours yearly at 5 cents per kilowatt-hour.

Next 100,000 kilowatt-hours yearly at 4 cents per kilowatt-hour.

Next 150,000 kilowatt-hours yearly at 3 cents per kilowatt-hour.

Next 775,000 kilowatt-hours yearly at 2.5 cents per kilowatt-hour.

Excess over 1,100,000 kilowatt-hours yearly at 2 cents per kilowatt-hour.

Yearly minimum guarantee 75,000 kilowatt-hours.

Breakdown service charge includes a minimum guarantee of $24 per year per kilowatt of maximum demand.

These rates do not include lamp renewals but standard incandescent lamps will be sold to customers at cost, or will be provided at 0.5 cent per kilowatt-hour.

Vacuum Cleaner Campaign in Kansas City.

The Electric Shop of the Kansas City Electric Light Company was featuring vacuum cleaners in its publicity campaign for the first weeks of April, during which the spring "cleanup" campaign is taking place. These cleaners were in heavy demand during the electric show, March 25 to April 3, and more than 70 were sold. It was estimated that the connected load of the company attributed to household devices was more than doubled as a result of the sales made at the show. The normal increase in load is about 75 per cent a month due to these devices. Vacuum cleaners were especially featured at the show, three being given away as prizes, and the newspaper and other advertising featuring them.

Increased Production of Motor-Driven Plant Pays for Electrical Installation.

An instance in power solicitation which strikingly emphasizes the error of comparing central-station service with isolated-plant operation solely on a cost per kilowatt-hour basis is brought out in a recent transaction in Rockford, Ill. Two separate plants, the Forest City Knitting Company and the Rockford Drilling Machine Company, both owned by the same stockholders, each operated its own isolated power plant and in both the highest efficiency was being obtained. The knitting plant operated 24 hours per day, necessitating the employment of two engineers. The night watchman attended to firing for the night shift, so only one fireman was employed. The Rockford Drilling Machine Company operated 10 hours per day, one engineer and one fireman being employed.

All efforts of the Rockford Electric Company to interest these companies were of no avail, because of the low cost at which energy was being produced by the individual companies. Finally, however, H. K. Hutton, power engineer of the company, conceived the idea of connecting the two plants, which are only about 75 feet apart, with a high-pressure steam line so that both could be heated from the boiler room of the knitting mill.

With this anticipated saving in labor in view, the management of the knitting mill allowed a trial motor to be installed for driving 28 knitting machines knitting men's socks. This motor was operated for one month and during that time it was found, from careful records, that the production had been increased 8.4 per cent in this department.

This performance so impressed the owners that a contract for service was signed and the question arose, "How quickly can both plants be entirely electrified?"

The plants have been in operation under the new conditions several months and it is already evident that the increased production alone is paying for the electrical installation.

In addition, by serving both plants from a central heating system the services of three engineers and one fireman have been dispensed with, representing a saving in labor of $300 per month. The engine rooms in both buildings have been dismantled and converted into stock rooms.

The motor installation in the knitting mill aggregates 75 horsepower, while 125 horsepower in motors is installed in the Rockford Drilling Machine plant. Both boiler plants have been retained so that one can be used while the other is being cleaned.

Electrical Construction

SOME SAFETY-FIRST FEATURES OF ELECTRICAL CONSTRUCTION.

By Norman G. Meade.

It has frequently been said that to make machinery "fool-proof" the fools must be removed, but literally we must accept the meaning of the phrase as the elimination of the human element as far as possible in machinery operation. Furthermore, safeguards must be provided to prevent possible accident to operatives and those whose occupation takes them in close proximity to various classes of machinery. The slogan "Safety First" should be interpreted in its broadest sense, and not only accepted as the prevention of accidental injury to employees, but to the machinery itself, which secondarily causes additional losses by delays and reduced production.

Traveling Cranes.

There is probably no more severely taxed piece of machinery than the electric traveling crane, but it has been

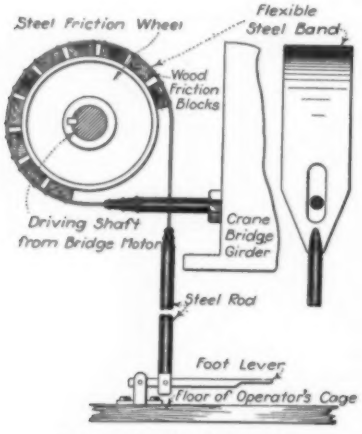


Fig. 1.—Mechanical Brake.

only for a comparatively few years that serious attention has been given to the development or to the improvement of safety devices to prevent such possible accidents as running wild, overhauling the load, and overtravel of the hoisting machinery.

In the older types of electric cranes it was customary to check the bridge travel by "plugging," that is, reversing the bridge motor. Twice within a short time, in a plant where the writer had charge of the electrical installation, the dependence upon this method narrowly missed terminating in fatal accidents. In both instances the power was temporarily shut off. In one accident a foundry crane crashed through the end of the building and

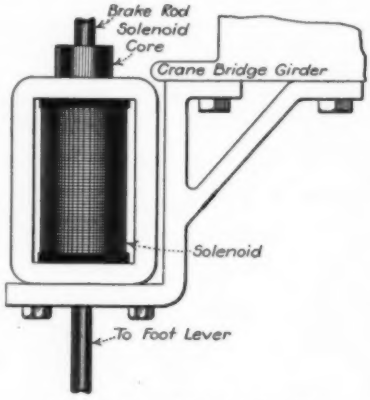


Fig. 2.—Mounting of Solenoid.

remained balanced in the opening. In the other case the crane in one end of the machine shop ran into the wall, wrecking a large idler pulley that carried a large belt from one side of the shop to the other. This led to the installation on the cranes of manually operated brakes, and the operators were instructed to use them entirely for stopping the bridge travel, but the seemingly extra exertion proved too much, and the "plugging" was continued, causing severe strain on the bridge motor and rapid wearing away of the commutator from flashing. This led the writer to devise an electrical attachment for the mechanical brake that could be employed except in emergencies when the power was suddenly shut off.

Fig. 1 shows the details of the mechanical brake as first installed. A steel friction wheel was mounted on the driving shaft geared to the bridge motor and was encircled by a flexible steel band with friction blocks attached to the inner surface. One end of the band was made fast to the bridge girder and the other was connected by a steel rod to the foot lever in the cage. By pressing down on the foot lever the band and friction blocks were drawn tightly about the friction wheel and the friction was sufficient to bring the crane to a stop within a few feet.

The electrical attachment consisted of a solenoid operating on the brake rod and suitable switching devices. Fig. 2 shows how the solenoid was applied. The brake rod was cut and a piece removed, the two ends of the rod were screwed into the core of the solenoid, the latter being mounted on a forged bracket attached to the underside of the bridge girder.

Connections for the electrical brake are shown in Fig. 3. A bracket was attached to the bridge controller for holding a push-button that connected with an automatic switch controlling the current for the solenoid. Practically any degree of braking can be secured, depending upon the time the button is held closed.

Another prolific source of accident is the overtravel of the hook blocks on electric cranes. Numerous inefficient devices have been used in the past, but reliable devices for averting such accidents are now on the market. One of these is shown diagrammatically in Fig. 4. Briefly, it consists of a cast-iron frame in which are located proper cam-operated contacts, which are protected by a sheet-iron cover. The operating

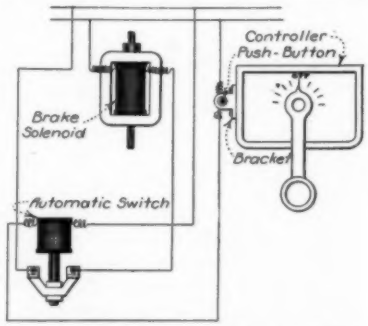


Fig. 3.—Electrical Connections for Brake Solenoid.

mechanism consists of a steel cable and sheave, and cast-iron weights; gravity is the operating force. It is mounted on top of the frame of the trolley, and the resistance used in connection with it can be placed in any convenient location. When the limit of travel is reached the switch disconnects the motor from the supply lines and connects it in a closed dynamic-braking circuit, stopping the motor and machinery.

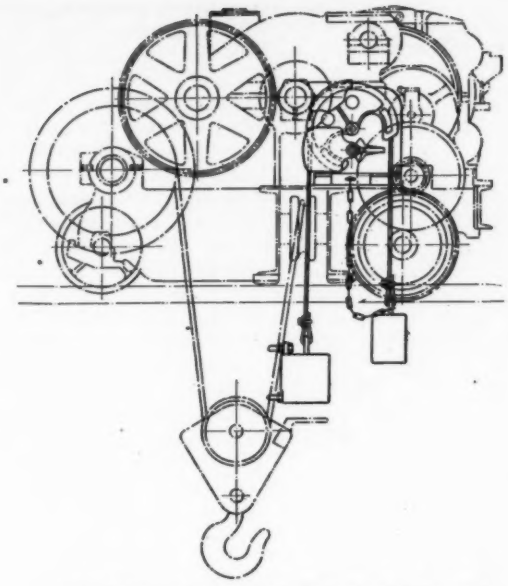


Fig. 4.—Mounting of Device to Prevent Overtravel.

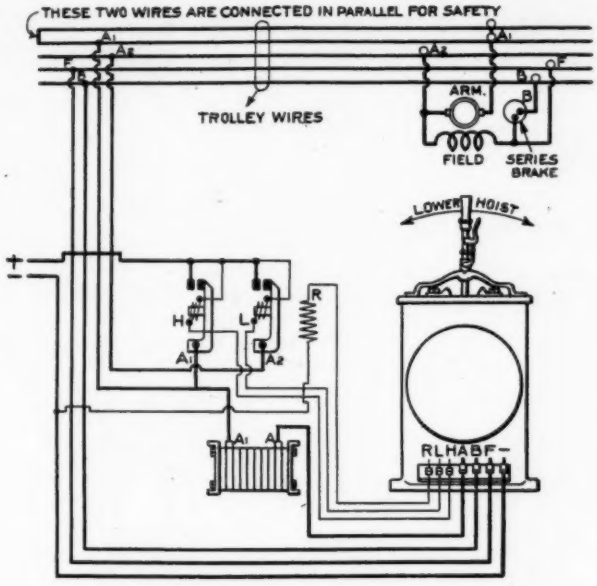


Fig. 5.—Connections for Dynamic Braking.

Dynamic braking is used largely on cranes at the present time, so that lowering is accomplished by this means or by power, depending upon whether or not the load is sufficiently heavy to overhaul the motor and driving mechanism. The selection of power of dynamic braking is entirely automatic and independent of the crane operator. Every well designed hoist mechanism has a magnetic holding brake, and, as dynamic braking will not actually hold a descending load, it is necessary that the magnetic brake be capable of stopping and holding the load. This brake comes into action only when the load has been brought almost to rest, so that it is subject to practically no wear. In order to secure reliable operation the brake should be series wound.

If the voltage fails while an overhauling load is being lowered, the load cannot run away, and the speed is controlled in exactly the same way as though nothing had happened. At the off position of the controller the motor is disconnected from the line, but is not open-circuited. The armature, series field and a small amount of resistance are connected in a local dynamic-braking circuit as shown in Fig. 5 so that the heaviest load will descend slowly, even if the magnetic brake should fail, so that the off point of a controller is a safe position.

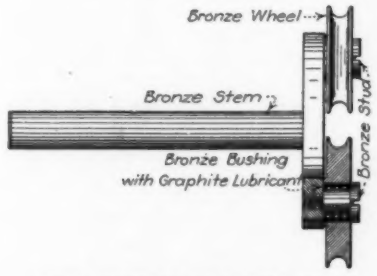


Fig. 6.—Collector for Electric Crane.

There are numerous secondary considerations in connection with electric cranes that may lead to accidents, among which may be mentioned the smaller auxiliary fittings and the wiring, including trolley wires and the feeder circuits connecting with them. The older type of plain grooved collectors should be discarded. as they wear out quickly, and are a constant source of wear to the trolley wire. A good form of collector that may be made up in any machine shop is shown in Fig. 6. It consists of a bronze stem and cross piece, to which are attacned two bronze wheels running on bronze bushings with graphite lubrication.

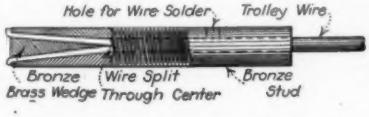


Fig. 7.—Anchor for Trolley Wire.

One source of much trouble and some danger is the trolley wires pulling out of the studs. There have been many expedients tried to prevent this, including drilling through the stud and wire and inserting pins. This is open to the objection that the cross-sectional area of the wire is reduced, and it is weakened. An effective method of securely anchoring the trolley wires in their studs is shown in Fig. 7. The rear end of the central hole is reamed out tapering and a brass wedge prepared that is somewhat smaller than the hole. The trolley wire is sawed with a hascksaw through the center lengthwise a distance a little greater than the length of the tapered portion of the hole. A small hole should be drilled radially into the stud, as shown, to admit wire solder. After tinning the end of the trolley wire, the hole in the stud and the wedge, and applying soldering solution, the wire is inserted into the stud, so that the split end projects enough to crimp the ends and the wedge is driven home. The gasoline torch is next applied and solder run in through the hole and at the wedge end.

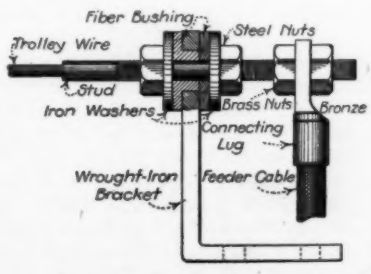


Fig. 8.—Support for Trolley Wire.

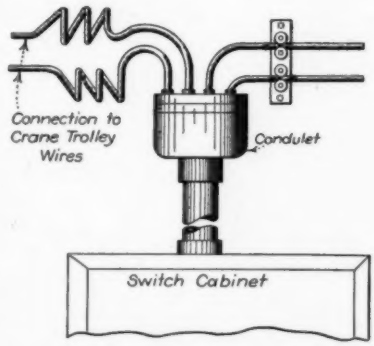


Fig. 9.—Connections From Trolley Wire to Cutout.

Supporting the ends of the main trolley wires for long runs should be carefully planned and so arranged that slack may be taken up without disturbing the feed wire connections, as shown in Fig. 8, which is self-explanatory. The wrought-iron bracket supporting the studs should be securely bolted to the girder supporting the crane track, and in preference to using a lock nut on the stud next to the bracket it is better to place a nut on either side, as shown. This will prevent a considerable amount of vibration of the stud and secure the insulation in place. Porcelain bushings will not stand the severe strain of the wire on the stud, so that fiber, vulcabeston or other similar material must be used for insulation.

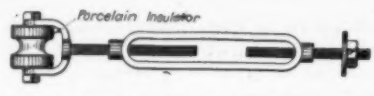


Fig. 11.—Turnbuckle for Supporting Insulator.

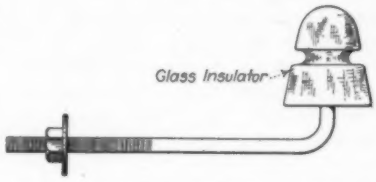


Fig. 12.—Outdoor Support for Insulator.

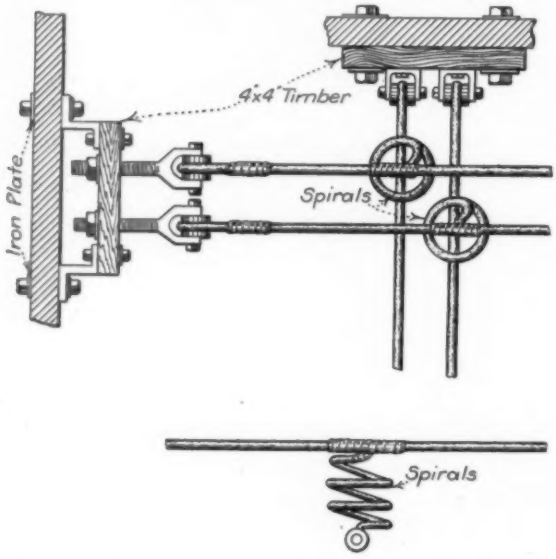


Fig. 10.—Method of Supporting Feeders.

Every main set of trolley wires should have a cutout switch placed in an iron cabinet located within convenient reach of the floor; a good location is immediately under the point where the feeders attach to the trolley-wire studs, and the wires or cables should be brought down the side wall in conduit, as shown in Fig. 9. As a precaution against strain on the connections, especially when taking up slack in the trolley wires, the feeder cables should be formed into spirals near the point of connection, as shown in the figure.

Too much care cannot be taken in supporting heavy crane feeders. They are frequently carried on the iron columns of the building near the roof, and should be anchored securely at each end of the run. Fig. 10 shows a substantial method of supporting the feeder wires, and it provides means of taking up slack by screwing up the nuts of the insulator supports. The vertical run of cables leads down to the switch-box, from which there is a return pair to the trolley wires. The horizontal and the vertical runs are connected by spirals of cable to give flexibility. Where the runs of cable are exceedingly long, and there is a liability of a good deal of slack, the turnbuckle arrangement for supporting the insulator, shown in Fig. 11, can be substituted for that shown in Fig. 10. For outdoor construction the device for anchoring can be made by welding a steel cross-arm pin to a steel rod, as shown in Fig. 12, and glass instead of porcelain insulators used.

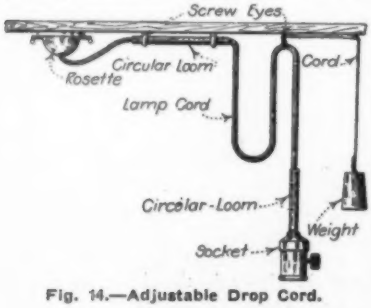


Fig. 14.—Adjustable Drop Cord.

Synchronous Alarm System and Lamp Suspension.

The alarm system shown in Fig. 13 was worked out primarily for a manufacturing establishment where some of the buildings were so far from the power house that the regular whistle could not be heard when noisy operations were in progress. It is a combination bell and compressed-air system, the compressed-air whistles being used where compressed air was available, and bells in other buildings. This arrangement has many possible variations, and can be used in any manufacturing plant to serve as a fire alarm.

A large solenoid, operated from the electric lighting mains and controlled from a switch in the engineer's office, blows the main whistle and closes a contact in the main circuit leading to the bells and small whistles. Relays are placed near the local application, together with a local battery. Practically any number of local circuits can be operated.

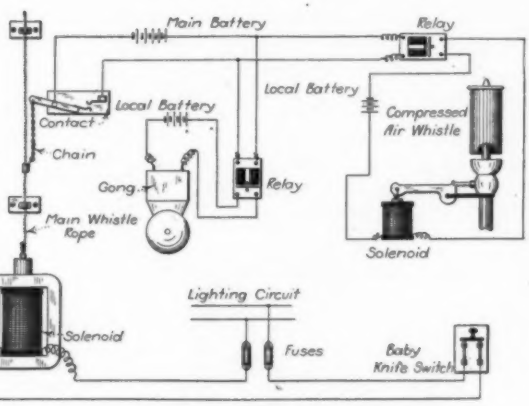


Fig. 13.—Connections for Alarm System.

Adjustable Drop Lamps.

In many classes of work, especially in machine shops, a light is needed at the tool, and the problem is to make it available when needed and provide some means for putting it out of the way when not in use. Further, it is important that it be securely installed, so that a severe jerk will not pull the

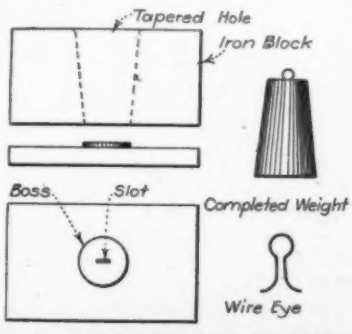


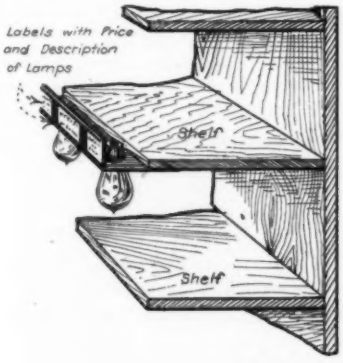
Fig. 15.—Counterbalance for Drop Lamps.

rosette down. The cord should be protected near the socket, as the oil on the operator's hands soon softens the insulation and exposes a person to shock where there is a ground on the line, which may cause the operator to jump enough to receive an injury by being caught in revolving parts.

Fig. 14 shows a substantial means for installing drop lamps. The cord near the rosette is run through about a foot of small circular loom secured to the ceiling with screw-eyes or straps. The height of the lamp is adjusted by the use of a small counterweight attached to a length of cord, run through screw-eyes and tied to the lamp cord. The weights can be made from scrap lead or babbitt metal by melting the scrap and pouring it into a tapered hole bored in an iron block, as shown in Fig. 15. A plate with a thin boss is made to fit the small end of the hole, and a small slot in the boss serves to hold a wire eye, shaped as shown, which will be caught securely in the molten metal.

Lamp Display Rack.

Having tried all the various methods of displaying lamps in our store we



Rack for Displaying Lamps.

finally worked out the following: We had a heavy piece of sheet iron bent into an L shape and one side punched for No. 877 receptacles. This allows the wires to be gotten at any time and makes a neat and finished appearance. Reference to the illustration shows more clearly the idea.

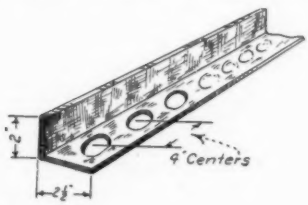
E. M. Raetz.

Among the Contractors.

The value of personal attention to the electrical business is shown by the remarkable growth of the New York business owned by A. Edgar Goetz. In 1910, Mr. Goetz started his electrical activities in small quarters (about 200 square feet) at 39 Cortlandt Street and since that time has outgrown three successive offices, until now he is about to move to new quarters at 55 Barclay Street running through to 56 Park Place, where with a floor area of 4,000 square feet, he will have one of the largest establishments handling electrical supplies and repairs in the downtown district of New York City. While the details of business have necessarily expanded during this period, yet Mr. Goetz finds time to give each detail his personal attention, and in this factor can be found the root of his success. Mr. Goetz does a general electrical business, and if specializing could be emphasized, it might be found in the departments of special lighting fixtures and general motor repairs, including alternating-current and direct-current motors. He has the distinction of having the only shop in New York City equipped with single-phase and two-phase alternating current and also Edison direct current. These are for repairs and testing. A host of personal and business friends wish Mr. Goetz every success in the new move, and prophecy that the new quarters will soon be too small for his rapidly increasing business.

The partnership between G. M. Findlay and E. Mattoon has been dissolved by mutual consent. The electrical business will hereafter be conducted by C. D. Mattoon & Company, with headquarters at Fort Atkinson, Wis.

Edwin W. Webster has purchased the business and stock of electrical goods of J. T. Hale at Columbus, Wis.



Mr. Webster is a graduate of the Bliss Electrical School at Washington, D. C.

Charging and Repair Station for Springfield, Mass.

Springfield, Mass., has a new industry which will enlist the interest and support of users of electric vehicles. It is a charging and service station for storage batteries and is conducted by the W. H. & Webster Jones Company, at 158 Chestnut Street.

One room of the store is devoted to a charging station. Here 440-volt alternating current received from the United Electric Light Company is converted into 110-volt direct current. The batteries are grouped on charging tables in numbers according to energy requirements. The front part of the building is occupied by the office and new battery stock room.

PERSONAL-DEVELOPMENT RETURNS.

By F. Day.

The point of diminishing returns is reached when mass production, systemization or specialization is carried to a stage where the cost of effecting the efficient or desirable principles increases in a greater proportion per unit of output than the profits.

This point is very carefully studied in the foundation of large industries and in the installation of modern business methods, but is seldom, if ever, even slightly considered in the foundation of an individual life-work or in the development of a personal career.

Much has been said, and we are still being reminded, of the dearth of very high values in executive abilities. The general experience has been that but a very small proportion of men with latent ability really reach a full development. This is as natural as all other forms of inertia. But once development has been started the same analogous law of inertia will keep the evolution of a man's abilities in progress.

In the industrial and commercial world we have annually several thousand college and university graduates taking up "Student Courses" with this corporation and that. Each is considered for his latent possibilities, and not for the immediate direct returns from his labor.

Most of these young men are engineers, highly specialized in education and very deficient in experience. Again inertia has its course and the already specialized knowledge is further developed.

Too much has already been said about "jacks-of-all-trades" (or professions), but likewise too little stress has been placed on the "masters of none."

Neither that the complication of our present-day organizations and industries requires the specialist in large numbers, nor that great opportunities in this field are awaiting the man with intelligence and ability plus is denied, but before any specialist can evolve into a successful executive he must master not only one phase of, but the complete, profession in which he is engaged.

The opportunity to learn the associated department's functions, the continual implied request to learn the boss's job and the vast possibilities in personal development all seem to be laid aside each day because no immediate direct returns are visible. The daily repetition of any act, with slight variations, specialized or not, has never evolved anything but a worn-out machine.

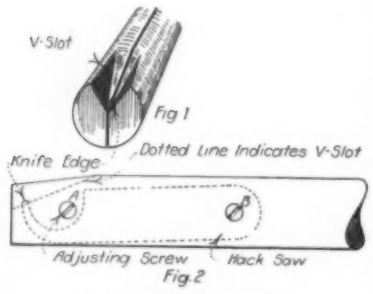
Why not know something about the boss's job, or the department next door or the relation of the company by which you are employed to the consumer of the product which it furnishes?

Dollar Wiring Kinks.

Every reader is invited to contribute to this column. It does not matter how few words are used to explain a "Dollar Wiring Kink," provided the idea is made clear; and if a diagram is necessary, a rough pencil drawing will serve. The idea itself must, of course, be new and bright. A dollar will be sent to the contributor upon publication.

Cotton-Wire Skinner.

A handy tool for skinning wires can be easily made up as follows: Take a piece of five-eighth-inch round stock about six inches long, split through the center for 2.25 inches, as in Fig. 2. Cut a V-shaped groove at the end half way through, as in Fig. 1. Drill two holes through the stock 0.5 and 2 inches from the end at right angles to the slot. The cutter is made up of a piece of hack-saw blade ground to shape, as in Fig. 2. Screw B goes through the hole in end of blade, while screw A is the adjusting screw adjusting the blade for all sizes of wire. By sliding the tool over the wire the knife edge



Tool for Skinning Wires.

will cut through the insulation, making it come off very easily.

B. V. Ferrari.

Locating Hidden Iron Switchboxes.

Quite frequently we have had switchboxes plastered over, causing considerable inconvenience and delay. Locating them by tapping on the wall about the place you judge the switch to be is very misleading and unreliable, and usually results in opening the plaster at the wrong place.

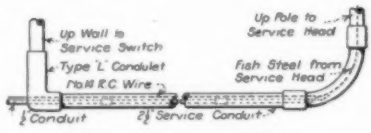
A very simple and accurate method is to use a small pocket compass. Each side and the top and bottom of the box can be found by *slowly* moving the compass close to the wall about the height the switch is supposed to be, first from one side to the other, and finally up and down, marking each place the compass needle shows the greatest deflection. With a little practice and patience one may quickly find a switchbox without very much trouble.

Always remove from the pockets screw-driver and pliers or any iron objects, as they will affect the compass more or less. W. C. Harvey.

Fishing for Service Cable.

Being unable to get my fish steel through an extremely long service conduit, I used the following method. The conduit was straight, but owing to the extreme length of it and the steel being rather limber, I was unable to get the steel through the pipe.

I took a piece of one-half-inch conduit, of which I had plently, and fastened a piece of No. 14 rubber-covered wire to the end. By pushing in the



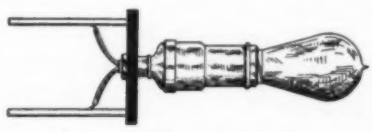
Fishing in Service Condult.

conduit through a type "L" condulet in the basement and screwing on additional pieces of conduit, I was able to get the conduit to the elbow at the pole. By withdrawing the conduit the No. 14 wire was left in the larger pipe at the elbow.

By using a fish steel from the service head on the pole I was able to pick up the No. 14 wire. With the No. 14 wire I pulled in a rope and had no further difficulty in pulling in my heavy service cables. J. H. Hilfiker.

Test Lamp.

A very good means for testing circuits on a panelboard for blown-out fuses can be made by taking the blades of a knife switch and the fiber that holds the handle. Drill the hole where the handle was for one-eighth inch pipe and put a one-eighth inch keyless socket on a short one-eighth inch nipple, fastening it with a one-eighth inch lock nut. Then wire to the two



Test Lamp.

blades with fixture wire. Use four-candlepower lamp. This outfit can be handled very easily with one hand when testing a circuit. Le Roy Murray.

Leather Heads on Nails.

A convenient method for threading leather heads on nails is the following: Get a board of hard pine wood, two feet long and ten or twelve inches wide; bore a one-fourth-inch hole about eight inches from one end on the center line of the board, and another hole one inch from the first and five-eighths inch in diameter. Join the two holes with a quarter-inch slot. Support one end of the board on a box or chair and the other end on another chair. The operator sits astride of the board. He places a handful of leather heads in front of him on the end of the board, and a box of nails at one side. Under the large hole in the board is placed a box for receiving the finished nails. The point of a nail is stuck in a leather head, which is then dragged over the quarter-inch hole and the nail given a rap with the hammer. Then the nail is slid through the slot to the larger hole and let drop into the box below.

Gilbert Johnson.

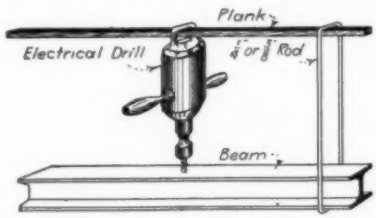
Supporting Fixtures.

At all fixture outlets a seven-eighths-inch board is required to support the fixture; otherwise a fixture block is necessary. A board laid on the plaster and nailed to the floor beams is not secure, and is likely to break the plaster. I nail cleats on each side to the floor beams and nail the board to these cleats. The board can then come flush with the floor beams.

Ernest Knierim.

Putting Pressure on Electric Drill.

Being compelled to use an electrical



Hanger for Electric Drill.

drill on steel beams or other iron hangers, I find it a very difficult matter to do so by hand, so I take a piece of ¼ or ⅜ iron rod and make a hanger, as shown in illustration, so I can hang it under or over the beam. Then I use a piece of wood 3 or 4 feet long and by putting it through the handle of the drill and in the hanger I have the same leverage as on a machine drill.

George F. Ernst.

Heater Coil.

To make a spiral coil for heating appliances without the use of a lathe or special machine, take a breast drill, put a straight rod or wire the size the coil is to be in the chuck, along with the end of the resistance wire. Make the brace fast in a vise and by turning the handle with one hand and feeding the wire on the rod with the other carefully, a neat, tight coil can be made.

R. F. Cooke.

Public Service Commissions

Conducted by William J. Norton

CALIFORNIA.

The United Light and Power Company has submitted a plan of reorganization to the Commission for approval. The company proposes to transfer all the properties of the United Light and Power Company of California and its four subsidiary companies, Equitable Light and Power, Consumers' Light and Power, Southside Light and Power and Central Oakland Light and Power Companies as well as the United Light and Power of New Jersey, to a new company to be known as the Consolidated Electric Company.

The new company will mortgage the properties so transferred to secure $3,000,000 of five-per-cent 40-year gold bonds, these bonds to be guaranteed by the Great Western Power Company. The latter company agrees to purchase $400,000 face value of the bonds.

It is urged that by combining the property of the United company with the Great Western Power Company and operating the two systems as a unit it will be possible to greatly reduce the cost of operation and eliminate duplication of expenses.

The Second Annual Report for the year ended June 30, 1914, has been issued in bound form. The report includes a review of the work of the different departments of the Commission's force; brief accounts of the formal and informal cases decided and cases taken before the courts; and statistics for all companies under its jurisdiction.

The City Electric Company, of San Francisco, was authorized to issue $426,000 face value of its first-mortgage, five-per-cent, 30-year sinking-fund gold bonds, with the provision that the company issue $250,000 of the bonds at 84 and accrued interest at the present time.

IDAHO.

Merger of the Southern Idaho Power Companies. The attorney general of Idaho has designated the commission to act as his agent in making an investigation to determine whether or not "the Idaho-Oregon Light & Power Company, the Idaho Power & Light Company, the Great Shoshone & Twin Falls Water Power Company, the Idaho Railway, Light & Power Company, the Southern Idaho Water Power Company and the Utah Power & Light Company, have formed, or are about to form, a merger which will result in uniting the interests of the companies named, in the hands of a holding company which is, or will be organized, for the purpose of conducting within the State of Idaho the business of the said companies, and to specifically determine in the above matter, (1) whether such a combination, or merger, has been formed, or is in the process of formation and the exact nature and effect thereof; and (2) whether these various companies named are subject to the laws of this state to such extent as will give our courts jurisdiction to restrain the formation of such combination, or to dissolve the same if it has actually been consummated." The Commission issued an order to these companies arranging for a hearing in the matter on April 23.

The Utah Power and Light Company was granted a certificate of convenience and necessity to construct and operate a distribution system for the furnishing of electricity for light, heat and power purposes in the towns of Parker, Tremont County; Menan, Jefferson County; and Ucon, Bonneville County.

The Pacific Telephone and Telegraph Company. The Commission has denied the application of the Pacific Telephone and Telegraph Company for permission to place in effect a new schedule of inter-exchange telephone rates in Idaho. The proposed rates would reduce the initial period from three minutes to one minute and the Commission found that the one-minute-initial-period plan would not be practicable in the territory served.

KANSAS.

The Emporia Telephone Company. The order of the Kansas Public Utilities Commission, which dismissed the application of the Emporia Telephone Company for permission to raise rates on its four-party-line service, has been set aside by Judge G. H. Whitcomb in the second division of the Shawnee County District Court. The court also issued an injunction, at the request of the company, to prevent the Commission from bringing legal action against the telephone company should the company raise its rate prior to the determination by the Commission of a reasonable rate. The court says: "I have issued this injunction, in view of the heavy penalties incurred for violation of this law, and because no other adequate remedy exists." The Emporia Telephone Company asked permission to raise its four-party-line rate from $1 to $1.25, and under Judge Whitcomb's decision, coupled with his injunction order, the company may place in effect its $1.25 rate until such time as the Commission shall fix a fair and just rate, that meets the approval of the District Court. The court finds that the present rate does not afford a proper return on the investment; and holds that the company is entitled to earn 8 per cent on the investment, including going value, and that 8.3 per cent is a reasonable allowance for depreciation.

Counsel for the Commission stated that the case will be appealed to the Supreme Court.

MASSACHUSETTS.

Milford Electric Petitions. The Board has issued an order, March 20, 1915, fixing maximum rates for electric service of the Milford Electric Light and Power Company. During the investigation criticism was heard regarding the company's differential prices for both light and power services, and the decision says: "So far as these prices are expressed in the form of special rates, such rates should be discontinued, and what is offered to any one customer should be open to all who desire to avail themselves of their terms and who seek the company's service under like conditions. Beyond this recommendation it has seemed to the Board, for reasons so often discussed as not to require repetition here, that it should deal in such a proceeding as this only with the maximum net price to commercial customers and the prices for street lighting. Other prices, both for power and light, are made chiefly from motives of commercial expediency to obtain business which cannot otherwise be obtained. But all who pay the maximum price, and the town with respect to its street lighting, must buy of the company or go without electricity and they are entitled to receive the utmost consideration of the Board."

NEW JERSEY.

Judge John W. Slocum, from the Court of Common Pleas of Monmouth, has been appointed as the successor of Thomas J. Hillery on the Board of Public Utility Commissioners. The appointment is for a full term of six years. All three commissioners are now Democrats, and for the first time the Board has been made a solidly partisan body.

Franchise Value. The House has defeated the Pierce Bill, which provided that, in determining charges for rates of service of public-utility corporations, no consideration is to be given by the Board of Public Utility Commissioners to franchises as part of the value of the corporation's property.

NEW YORK—Second District.

The New York Telephone Company has been ordered to extend its Utica rates so as to apply to the New Hartford and Whitesboro exchange areas. Some time after taking over the property of the Utica Home Telephone Company, the New York Telephone Company increased the charges to the subscribers of these exchanges by establishing toll charges. A number of complaints were received by the Commission, and after formal hearing the order extending the Utica rates, and thus eliminating the toll charges, was issued. The Commission, in its opinion, states that if authority to suspend advanced telephone rates, pending investigation, had been conferred upon the Commission before these complaints were filed, the proceeding would have been simplified, the subscribers so greatly dissatisfied with the introduction of the Utica toll rate would have retained their telephones pending investigation and order, and the whole matter would have been disposed of to the better satisfaction of all parties. The Legislature has been asked to amend the law in this respect.

The Ithaca Gas and Electric Company. The Second District Commission has approved the consolidation of the Ithaca Gas Light Company and the Ithaca Electric Light and Power Company into the Ithaca Gas and Electric Company with a capitalization of $350,000.

The new company is also authorized to issue $434,000 of its five-per-cent 40-year, first-mortgage bonds, of which $319,000 will be used to exchange, par for par, $254,000 outstanding bonds of the gas company, and $65,000 outstanding bonds of the electric company. The remaining $115,000 shall be sold at not less than 90 to net $103,500 to fund bills and accounts payable of the gas company to the amount of $74,800.50 and of the electric company, $28,556.06.

OHIO.

The Brookville and Lewisburg Lighting Company was authorized to issue its common capital stock of the total par value of $5,000, to be sold at not less than par. The proceeds will be used to construct an electrical distributing system.

The Greenville Electric Light and Power Company was authorized to issue its common capital stock of the total par value of $8,000, to be sold for not less than par. The company will use the proceeds in constructing an extension to its high-tension transmission line.

OREGON.

The Eighth Annual Report of the Oregon Railroad Commission, for the year ending December 15, 1914, has been issued. The decisions of the Commission upon formal and informal complaints during the year are given, and abstracts of the annual reports of the companies under regulation are also given.

In its recommendations for legislation the Commission suggests that changes in the law be made to eliminate unnecessary duplication of reports. At present accidents are to be reported to the Railroad Commission, to the Labor Commissioner and to the State Industrial Accident Commission. The Commission says that one report to one officer or Commission is sufficient. The Commission further suggests that by a rearrangement of the dates upon which annual reports to the Tax and Railroad Commissions are made, standardization of reports to these bodies will be possible. By such changes, unnecessary expense both to the state and to the corporations can be avoided.

WISCONSIN.

Ladysmith Lighting Company. The Commission issued an order March 4, 1915, changing the rates of the Ladysmith Lighting Company from a straight meter rate of 10 cents per kilowatt-hour, to a block meter rate of 10 cents per kilowatt-hour for the first 40 hours' use per month of active load, 8.5 cents per kilowatt-hour for the next 60 hours' use, and 6 cents per kilowatt-hour for all excess. The company had provided no rate for power except the regular 10-cent rate. The Commission fixed a tentative power rate of 50 cents per month per horsepower of nominal rated capacity, plus 4 cents per kilowatt-hour of energy consumed. The Commission says: "It is the aim and duty of the utility to extend its service to reach as many consumers as possible, hence it is thought advisable to establish as low a power rate as is consistent with the operating conditions."

In determining reasonable rates the Commission made its ausual investigations to determine the cost of service, apportioning expenses between demand and energy charges and apportioning these items between commercial and street lighting. In regard to minimum charge the Commission says: "The minimum charge covers certain items in the operating expense of the plants, which bear little or no relation to the current sold. Such expenses vary with the number of consumers, since they are incurred through the customer being connected with the plant, and specific expenses being incurred on his account. The expense of reading meters, maintaining meters, delivering bills, and carrying the customers' accounts are expenses which fall in this category. When no minimum charge is made the company incurs expenses for these consumers who pay little or nothing to the company and when such costs are not borne by the consumers for whom they are incurred, they invariably are saddled upon other consumers and are, therefore, in a sense discriminatory."

The company had in effect a minimum bill of $1.00 and also a meter rental of 25 cents. The meter rental is abolished and the minimum is placed at $1.00 per month.

The Commission repeatedly calls attention to the lack of proper records in this case, and says: "If utilities persist in operating blindly with only a superficial knowledge of such facts as accurate cost data, the amount of service produced, proper consumer statistics, etc., when at practically no expense the proper data may be secured which will place them upon a sound basis, they have only themselves to blame for their inefficiency."

It was also found that the Commission standards of service for electric utilities were not being observed and that the company had taken no steps to correct defects in its service which have been pointed out. The company is ordered to comply immediately with the order relating to the improvement of its service.

The Omro Electric Light Company. Petitioners asked that the operating period of the Omro Electric Light Company be extended and reasonable rates established. It appeared that the extension of the period of service was a convenience rather than a necessity, and the patrons of the company were given an opportunity to choose between a reduction in rates and an extension of service. A schedule of rates was ordered substantially the same as those in effect and the time of operation extended.

In investigating the value of the property it was found that certain property was paid for out of earnings.

The Commission says: "It is quite clear that property paid for out of earnings is as much the property of the respondent as though paid for by new capital. Such earnings might have been first distributed among the stockholders as dividends and later returned for investment."

The petitioners endeavored to establish that the amount paid for wages and salaries is excessive. "Concerning this contention, it may be said that the manner in which the expenses are divided between management and other accounts is not so very material to the public, but that the total cost of service must be maintained within reasonable limits. A rule that the actual expenditures should be controlling, in fixing rates, regardless of what they may be, could not be made to stand, for reasons too obvious to require mention. Costs, therefore, must be examined and tested. If wages and salaries are unusually high it is not unreasonable to expect that a consequent greater efficiency will reduce the expenses in other directions. But, if unusually high wages and salaries are not exceptionally productive, they must be considered partially as a disposition of the net income." It is suggested that expenses can be compared with utilities operated under similar conditions, in order to test their reasonableness, at least in the aggregate.

The company asked, for, and was granted the right to abolish its flat rates. The Commission states that it has found repeatedly that flat rates lead to waste of service and inequality of charges, and has been inclined to authorize the continuation of such charges only when unusual conditions require it.

The petitioners requested "that the respondent be required to refund to the consumers any and all moneys collected from them in excess of a reasonable charge for service heretofore furnished."

In regard to such request for refunds the decision says: "It has not been shown, nor do we find that the rates on file with the Commission are not the respondent's lawful rates. The petitioners make no claim that the respondent's charges are not in accord with schedule on file, but appear to rest their claim for refund upon a difference between actual and reasonable charges. Even if the Commission should now find that the respondent's rates are excessive for the service which it renders, the Commission's order would be incompetent to grant to the petitioners any refund on account of past services. Since the Commission's order as to rates can deal only with future charges, that portion of the petition which relates to refunds must be dismissed."

Physical Connection of Telephone Lines. The Belmont and Pleasant View Telephone Company and the La Fayette County Telephone Company are ordered to restore physical connection between certain parts of the telephone systems. The physical connection had been discontinued because the companies were unable to agree upon the terms. The Commission outlines a method of determining proper payment for the service in question, and includes in its order a provision for settlement between the companies in this case.

The Darlington Electric Light and Power Company applied to the Commission for authority to increase rates. Subsequently the ownership of the property passed into the hands of the North American Company and this company submitted a complete copy of the rate schedule of the Milwaukee Light, Heat and Traction Company asking that these rates be applied to the Darlington property. The Commission says: "The schedule submitted by the petitioner is of the same nature as that which has been adopted for practically all of the North American Company holdings in this state. It provides in its essentials for a Hopkinson demand rate for both light and power service and a limiting increment rate for lighting service. It includes also a residence rate which bases the increment scale of charges upon the number of so-called active rooms, an off-peak rate, an optional power rate, and a short-time rate for both light and power consumers.

"The minimum charges as provided for in the schedule are 50 cents per month for residence service, $1.00 per month for commercial service and 75 cents per connected horsepower per month for power service."

Upon the original application, the Commission determined that a minimum bill should be established, rates to power consumers should be increased somewhat and rates to commercial lighting consumers should be slightly reduced. The commission finds that the rates proposed by the North American Company provide for these changes, and grants the application putting these rates in effect.

The Commission had also concluded that a special contract with the Darlington Brass Works should be abrogated and the regular power rates made applicable to this concern. The decision says, however: "We do not now feel that we can abrogate the contract under consideration due to the almost certain loss of the business, which would follow the increasing of rates; inasmuch as this particular company at times has consumed more than one-third of the entire sales of the utility, such a loss would materially affect the operating expenses so as to result in necessary increases in rates to the remaining consumers. Where such a condition is the result of loss of business the allowance of a rate differential in order to retain the same may be justified."

The Cameron Light and Power Company applied for a franchise under the Water Power Act (Chapter 755, Laws of 1913) to erect and maintain a dam for power purposes diverting about 80 per cent of the water of Red Cedar River into Cranberry Creek. The Commission finds no necessity for the proposed water-power plant and dismisses the application. The main reason for refusing the franchise grant is the fact that there is no proof that the proposed undertaking will tend to improve navigation, but would undoubtedly destroy navigation in the Red Cedar River. The decision says: "However, much it may be the desire of the Commission to encourage the development of water powers in the state of Wisconsin, the Commission is restricted by this law from granting franchises for that purpose except upon the conditions specifically set forth in the Water Power Act." This act expressly provides that such franchises can be granted only upon showing that it will result in the improvement of navigation.

Arrangements for National Electric Light Association Convention Practically Complete.

Through the concerted activity of the secretary, master of transportation, and hotel committee, arrangements for a very successful convention by the National Electric Light Association have been practically completed. The convention meetings will be held in the Native Sons of the Golden West Building, San Francisco, Cal., June 7 to 12.

Four special trains, the red, green, blue and pink specials, have been arranged for. Three of these will travel on circular tours, taking 23 to 30 days for the complete round trip which will include many stops at points of great scenic and electrical interest, besides a week's stay at San Francisco. The general itinerary of these trains was given in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of January 30, 1915. It is urged that all desiring to take these special tours should make early reservations with George W. Elliott, master of transportation, 29 West Thirty-ninth Street, New York City, from whom illustrated booklets giving the detailed itinerary of each trip can be obtained.

The Hotel Committee has made arrangements at a considerable number of fine hotels close to the convention hall.

Questions and Answers.

All readers of the Electrical Review and Western Electrician are invited to submit questions and answers to this department. Full names will not be printed except where the writer indicates his willingness therefor. Anonymous communications will not be considered. Questions relating to electrical matters of any kind will be inserted. Answers from our readers should be received in this office preferably within ten days of the date of publication of the question, and will be published in a subsequent issue. Payment will be made for all answers published.

Questions.

No. 276.—Moonlight.—Although the matter may not be electrical, I venture to ask through your columns the reason for the different color of the moon when observed late on a bright afernoon before full moon and when seen ordinarily on a clear night. In the former case it seems very white, while in the latter it has a distinct tinge of yellow.—D. L., River Forest, Ill.

No. 278.—Speech Making by Telephone.—Is it feasible to arrange a system of loud-speaking telephones to enable a prominent public speaker to addess at the same time not only the audience gathered at the main meeting hall, but also people assembled in overflow meetings near by? Has this ever been done and with what success?—H. N., Philadelphia, Pa.

No. 279.—Electric Radiator Outlets.—In southern cities where no permanent heating system is provided in buildings it is customary to use a small grate fire, oil stove or gas radiator on the few mornings when it is necessary to take the chill from the room. As the use of electric radiators is likely to increase for this purpose, is there any way to insure that wall outlets that would be used for such radiators taking 600 to 1,000 watts would be wired for sufficient capacity?—G. N. W., Galveston, Texas.

No. 280.—Closed-Circuit Burglar Alarm.—A garage situated in the rear of a large residence is to be provided with a burglar alarm of the closed-circuit type to prevent cutting or tampering of the wires. What kind of battery is best suited and cheapest to use on this circuit?—A. T., Evanston, Ill.

Answers.

No. 271.—Three-Phase Distribution.—Under what conditions is it preferable for a central station to distribute three-phase, four-wire, and when should three-phase, three-wire be used, 2,300 volts being assumed in either case?—P. E., Wheaton, Ill.

The four-wire three-phase system of distribution is coming into favor more and more for general distribution with mixed loads on a large scale. It is at present used by some of the largest companies in the country, among them being the Commonwealth Edison Company, of Chicago. In many states public service commissions having jurisdiction require that the voltage variation be kept within certain well stated limits—five per cent for lighting and ten per cent for power in Illinois—and it will often be found possible to keep within these limits with mixed loads when using four wires where the limits would be exceeded were three wires used.

The four-wire circuit is the one to use for mixed loads where good voltage regulation is necessary. Three-wire circuits answer the purpose and are the correct ones to use for balanced three-phase loads or where the single-phase load is small in comparison with the three-phase load. —I. L. K. R., Chicago, Ill.

No. 272.—Electric Shock.—In the case of electric shock, which is more dangerous, (a) direct current or alternating current, (b) high frequency or low frequency, (c) high voltage with small current or low voltage with large current?—T. J. S., Butte, Mont.

The question of electrical shocks and burns is one which has been given considerable thought by medical experts. Many theories have been advanced as to what physical phenomenon actually takes place in the human body as a result of the passage of an electric current. In the end it is only possible to advance an opinion based on actual experience and observation. In general, a higher voltage will cause a higher current to flow through the body than would be the case with a lower voltage. On the other hand, a longer duration of contact with a lower voltage through a perfect point of contact or a large number of points of contact would prove just as disastrous. Low currents at excessively high frequencies apparently do not cause any contraction of the muscles nor any great pain. This is very well evidenced in the practice of electrotherapeutics where frequencies above 10,000 cycles are used. In general, for equal voltages, more response will result from frequencies below 10,000 cycles and considerably less response at frequencies above 100,000 cycles. Shocks are in a different class from burns. Electrocution could easily take place without any visible burns. An electric shock generally causes a cessation of respiration, which may be the result of the overstimulation of the brain, paralysis of the nervous system, or paralysis of the breathing organs resulting in cessation of the flow of oxygen to the blood, and generally termed asphixiation.—C. P. A., Wilkinsburg, Pa.

No. 274.—Truing Commutators.—In turning up a commutator it is difficult to secure a smooth surface because the mica segments are harder than the copper and therefore are likely to remain as small ridges that will increase with wear of the copper. I was told recently that by soaking the commutator with oil the mica would become softened so as to give under the tool as readily as the copper, and therefore make a perfectly true commutator. Is this method effective? If so, how is the oil applied, by merely surrounding the commutator with oily waste or by immersing the entire commutator in oil? How long should the oil be applied?—P. H. E., Ashtabula, O.

The practice of applying oil to the surface of a commutator in sufficient quantity to soften the mica is in general not a practical one. If a very small amount of copper is to be removed, the use of oil might be effective so far as softening the mica is concerned, but the time required to accomplish the desired result would probably be greater than that needed to undercut the mica. Oil is highly detrimental to mica, and if applied at all lavishly may, and usually will, cause rapid disintegration of the mica, resulting in flat bars, burnt segments and flashovers (more especially with rotary converters). For this reason the use of oil should be strongly discountenanced.

It is true that high, hard mica seriously interferes with turning down a commutator with a cutting tool, but this can be greatly reduced by employin a low-cutting speed. Experience indicates that a speed below 550 feet per minute is ordinarily satisfactory.

If the mica be undercut or slotted, all trouble from high mica will be eliminated while the machine is being turned down and the operation of the machine will in almost all cases be improved. The commutators of machines having low peripheral speeds, so low that the centrifugal force is insufficient to throw out dirt, etc., should not be slotted, but all other machines seem to be the better for it.

The use of a grinding tool instead of a cutting tool will usually do away with all trouble on account of high mica during truing-up the commutator. It has the further advantages that but a minimum of copper is reduced, and leaves a truer surface than is possible where a cutting tool is used. One other advantage, and often a very important one, is that the commutator can be ground at normal speed, and even while operating in case of emergency, whereas with the cutting tool in nearly all cases speeds far below normal must be employed, and these are usually difficult to obtain.—I. L. K. R., Chicago, Ill.

No. 275.—Exhaust Fan for Restaurant.—In a restaurant 50 by 80 feet in floor area would the slight added cost of a motor-driven exhaust blower installed in the adjoining kitchen and connected to a concealed pipe with several inlets along the rounded cornice of the room not justify itself in improved ventilation compared to using two ordinary ex-

haust fans installed in the upper part of rear windows, one in the kitchen and one in the restaurant?—S. P. F., Detroit, Mich.

An exhaust fan with piped connections to registers located in the cornice of the kitchen and dining rooms of the restaurant should give decidedly better ventilation (if the proper sized pipes and fan are used) than a single disk fan in each room. The volume of air should be calculated from the room dimensions and a fan capable of exhausting four complete changes of air per hour from the dining room and about eight complete changes of air from the kitchen should be selected. Enough registers should be installed so that the velocity of air through the register faces is not more than 350 feet per minute, using the actual free area of the registers as a basis for this calculation. A velocity of 600 feet per minute may be used in the pipes to the fan and 750 to 1,000 feet per minute for the discharge pipe from the fan to the outside air. Short turns in the air pipes should be avoided wherever possible, as these tend to cut down the amount of air handled by the fan because they offer more resistance to the passage of air.

The following calculation may help to make this clear: Suppose the dining room is 50 by 50 by 15 feet and that four registers are to be placed around the room. Suppose, also, that the kitchen is 30 by 50 by 15 feet and it will have only two registers. Assume that the registers used have 80 per cent of their face as free openings.

Dining Room.—50 by 50 by 15=37,500 cubic feet.

At four changes of air per hour this equals 2,500 cubic feet per minute or 2,500/4=625 cubic feet per minute per register.

Free area of register is 625/300 or 2 square feet.

Actual area of register is 2/.8 or 2.5 square feet.

Registers measuring 19 inches quare will answer, but this is an odd size and an 18 by 20-inch register could probably be found in stock and would have the same area.

The pipe running to registers should have the following cross-sectional areas:

To last register 625/600 or about 1 square foot or 12 inches square.

To third register 2 square feet or 17 inches square.

To second register 3 square feet or 21 inches square.

To first register 4 square feet or 24 inches square.

Kitchen.—30 by 50 by 15=22,500 cubic feet.

At eight air changes per hour this means 3,000 cubic feet per minute for the room or 1,500 cubic feet per minute per register.

Free area of register should be 1,500/300 or 5 square feet.

Actual area of register would be 5/.8 or 6.25 square feet.

A register 2.5 feet square could be used.

The connecting pipe should be 1,500/600 or 2.5 square feet in cross-sectional area for one register, or 5 square feet for two.

Total.—Pipe from dining room should have 4 square feet area; pipe from kitchen should have 5 square feet area; pipe from both should have 9 square feet area or a little less. The pipe will then have to be reduced at the fan intake.

The fan should be large enough to handle 5,500 cubic feet of air per minute.

The discharge pipe should be not less than 5,500/1,000 or 5.5 square feet in cross section.

The above figures are such as would be used by the best ventilating engineers when figuring on a high-class job. If the job under consideration does not require the best possible ventilation, then the figures can be modified to suit the requirements. Heating and ventilating equipment manufacturers and dealers have catalogs showing fan capacities and from these a suitable fan or blower can be selected. But remember that a disk fan such as is often placed in the rear window of a kitchen or restaurant will fail to give results if it is required to draw or to blow air through any but the shortest lengths of pipe.—A. C. H. Hagerstown, Md.

No. 277.—BRIDGE MOTORS.—Is it necessary to operate lift or draw bridges by means of direct-current motors or can this be done satisfactorily by induction motors with secondary resistance control? I have been told by a bridge engineer that direct-current machines must be used even though the only available supply is three-phase, 60-cycle current.—D. A. T., Chicago, Ill.

The direct-current motor is the motor *par excellence* for lifting draw bridges and similar applications. For this class of work high starting torque, close control and dynamic braking are necessary. The direct-current series motor, or the compound-wound motor as the case may be, possesses these characteristics; the control apparatus is the simplest, and the dynamic is very effectively obtained.

The three-phase induction motor with variable resistance secondary also has high starting torque and good efficient running characteristics, and is coming into increasing favor for hoists, heavy-duty lifts, etc. The control apparatus is not quite so compact as that for direct current, and is more complicated.

If direct current is available, direct-current motors should be used, of course. On the other hand when alternating current only is available, it is doubtful if the higher expense involved in installing the apparatus for converting to direct current is justified, except where the duty is particularly heavy.

Querist might consult the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for February 13, 1915, answer to No. 261, in which the remarks concerning alternating-current hoist motors and dynamic braking apply, in general, to the present case.—I. L. K. R., Chicago, Ill.

The use of alternating-current induction motors with external rotor resistance will certainly give results equal to or better than direct-current motors when used on draw or lift bridges. An induction motor of this type should be capable of exerting from two to three times full-load torque at starting and that should be sufficient for all practical purposes when applied to lift bridges. The fact that induction motors with external rotor resistance are in use in hundreds of plants doing hoist duty and doing it satisfactorily should be conclusive proof that they are adapted to that kind of service. There are a great many such motors in use in this country doing hoisting for mines that have a rating of over 250 horsepower each.—A. C. H., Hagerstown.

The Scherzer rolling lift bridge recently completed for the Canadian Pacific Railway Company at Fort William, Ont., is operated by two 37-horsepower, 680-revolutions per minute, 550-volt, 60-cycle, three-phase motors. The two controllers operating these motors are geared together. The two end locks are motor-operated by a two-horsepower, 1,200-revolutions-per-minute, 550-volt, 60-cycle motor. The emergency brake is equipped with a three-horsepower similar motor. Operation of the bridge is completely successful with these alternating-current motors. The total weight of the steelwork and machinery is approximately 660 tons.—J. A. S., Montreal, Canada.

Society for Electrical Development.

The regular meeting of the Board of Directors of the Society for Electrical Development was held in New York on April 19. Henry L. Doherty, president, occupied the chair, and others in attendance were W. H. Johnson, A. W. Burchard, Fred Bissel, F. S. Price, E. W. Rockafellow (representing Gerard Swope), J. R. Strong, Hugh M. Wilson, Charles W. Price, J. M. Wakeman and J. Smieton. The general manager's report showed a membership of 1,253, and a balance in the treasury of $67,270.

It was voted to have the fiscal half-years (at which time the semi-annual dues are payable) begin April 1 and October 1 hereafter.

In addition to the running expenses of the Society, the sum of $50,000 was voted to be expended in developing Electrical Prosperity Week, to be held the first week in December of the present year. This sum was requested by the executive committee in charge, and will be expended under the direction of the committee, with the co-operation and advice of the Society officers.

Electrical Engineering Problems.

By R. G. Hudson and W. V. Lyon.

DIRECT CURRENTS.

Problem 33.

The ultimate temperature, dielectric strength and insulation resistance of the armature and field winding of a 25-horsepower, 230-volt, 1,200-revolution-per-minute shunt motor are to be determined after running the motor at full load for several hours. The temperature of the machine (cold) by thermometer is 25 degrees centigrade. Before starting the motor the armature and a variable series resistance are connected across the line and the armature current adjusted to 90 amperes. The difference in potential between two commutator segments, one under the positive brush and the other under the negative brush, is found to be 8.78 volts. These segments are then marked on the ends. The field winding and field rheostat are then connected across the line and the field current adjusted to 2.5 amperes. The potential drop in the field winding alone is found to be 162 volts. The motor with starting box is then connected across constant-potential 230-volt mains, brought up to speed and loaded until the output is 25 horsepower at 1,200 revolutions per minute.

The motor is operated continuously at rated load and speed until the ratio of potential drop to current in the shunt-field winding becomes constant. Under these conditions the shunt-field current is 2.5 amperes and the potential drop in the shunt-field winding is 195 volts. The motor is then shut down and with the armature and a variable resistance connected across the line the armature current is again adjusted to 90 amperes. The armature is turned until the marked segments lie under the same brushes as before and the difference in potential between these segments is found to be 10.8 volts. The motor is then disconnected from the 230-volt mains and all windings are connected to one side of a 500-volt main. The frame of the motor is connected to the other side of a 500-volt main through a 500-volt voltmeter of 60,000 ohms resistance. The voltmeter reads 45 volts. An alternating emf. of 1,500 volts is then impressed between all the motor windings and the frame for one minute.

Find (*a*) the ultimate temperature of the armature windings; (*b*) the ultimate temperature of the field winding; and (*c*) the insulation resistance between all the motor windings and the frame.

SOLUTION OF PROBLEM 33.

The resistance of the armature winding at 25 degrees (centigrade scale is used throughout) is given by [6]

$$R=8.78/90=0.0975 \text{ ohm.}$$

Similarly the resistance of the field winding by [6] is

$$R=162/2.5=64.8 \text{ ohms.}$$

Given the resistance of a copper conductor at 25 degrees, the resistance at any other temperature (t) is given by [17]

$$R_t=R_{25}[1+0.00385((t-25)] \text{ ohms.}$$

Solving this equation for t, we get

[47] $t=(260R_t-235R_{25})/R_{25}$ degrees.

Answer to Question a.

The ultimate resistance of the armature is given by [6]

$$R=10.8/90=0.12 \text{ ohm.}$$

Since the resistance of the armature at 25 degrees is 0.0975 ohm and the resistance at the ultimate temperature is 0.12 ohm, the unknown temperature is given by [47]

$$t=(260\times0.12-235\times0.0975)/0.0975$$
$$=(31.2-22.9)/0.0975=8.3/0.0975=85.1 \text{ degrees.}$$

It should be noted that this is the average temperature of the winding and that parts of the winding may be hotter than this. It is recommended in the Standardization Rules of the American Institute of Electrical Engineers that an addition of 10 degrees be made to the average temperature and the resulting temperature (95.1 degrees in this case) is assumed to be the temperature of the "hottest spot" in the winding. The same Standardization Rules recommend that in any impregnated cotton, silk, paper or other fibrous insulating material the temperature of the hottest spot should not exceed 105 degrees centigrade, as the insulating properties of such materials are uncertain at higher temperatures.

Answer to Question b.

Since the field resistance at 25 degrees is 64.8 ohms and the resistance at the unknown temperature (t) by [6] is

$$R=195/2.5=78 \text{ ohms,}$$

the unknown temperature (t) is given by [47]

$$t=(260\times78-235\times64.8)/64.8=78 \text{ degrees.}$$

Adding 10 degrees as before the temperature of the hottest spot is found to be 88 degrees.

In making the above tests it is also desirable to place thermometers in various parts of the machine before and after the run. The thermometer reading should be increased by 15 degrees when the thermometer bulb is separated from the winding by insulation and should be increased by 5 degrees when the thermometer rests upon a bare copper winding or commutator bar.

Answer to Question c.

The circuit consists of a 60,000-ohm voltmeter and the winding insulation, which are connected in series across 500-volt mains.

Since the voltmeter reads 45 volts the voltmeter current by [6] must be 45/60,000 or 0.00075 ampere. The total drop being 500 volts, the drop across the winding insulation must be 500—45 or 455 volts. The insulation resistance by [6] is then 455/0.00075 or 607,000 ohms (0.607 megohm). The Standardization Rules cited above suggest that this insulation resistance shall not be less than $V_t/(Kv.\text{-}a.+1{,}000)$ megohms where V_t is the rated terminal voltage of the machine and $Kv.\text{-}a.$ is the product of the rated terminal volts and line current divided by 1,000.

The dielectric strength of the winding is assumed to be sufficient if the insulation between all the windings and the frame is not punctured by a voltage equal to twice the rated voltage plus 1,000 volts maintained for one minute.

ALTERNATING CURRENTS.

Problem 83—Part I.

A 12-pole induction generator which has a full-load capacity of 1,000 kilowatts is driven by a prime mover whose speed-load characteristic falls from 254 revolutions per minute at no load to 252 revolutions per minute at full load. When delivering full load the slip must be 1.8 per cent. This machine is operating in parallel with a 1,500-kilowatt synchronous generator which is driven by a prime mover having such a speed-load characteristic that the frequency falls from 25.3 cycles at no load to 24.8 cycles at full load. Assume that the power delivered by the induction generator is proportional to its slip.

(*a*) When the induction generator delivers 800 kilowatts, what are the slip, the frequency and the power delivered by the synchronous generator? (*b*) What adjustments should be made so that the frequency will be 25 cycles when these generators divide a load of 2,500 kilowatts properly between them?

Part II.

A six-pole induction generator is operating in parallel with a four-pole synchronous generator. The governors controlling the speeds of these generators are adjusted so that the induction machine will run at practically a constant speed and the speed-load characteristic of the synchronous generator will fall 2 per cent from no load to full load. Both generators are rated to deliver 2,000 kilowatts at 6,400 volts. The hot resistance of the rotor winding between terminals referred to the stator is 0.94 ohm. In determining the output of the induction generator neglect the resistance and reactance of the stator, the reactance of the rotor and all of the losses. This will, of course, give only an approximate solution, but the error is probably within about 10 per cent. (*a*) For what full-load speeds should the governors be adjusted so that these generators will properly divide a load of 4,000 kilowatts delivered at a line voltage of 6,400 volts and a frequency of 25 cycles? (*b*) Without disturbing the governors, how will they divide a load of 2,000 kilowatts delivered at the same voltage?

SOLUTION OF PROBLEM 83.

Part I. Answer to Question a.

When an induction machine is running as a motor, its speed is a little below that of synchronism. If the *frequency* of the circuit to which it is connected is in some way maintained *constant* and the speed of the machine is increased above that of synchronism, it will then act as a generator. This action is similar to that which takes place with a direct-current shunt machine which is connected to a *constant-potential* circuit. If, for example, the no-load speed is 1,200 revolutions per minute, it will act as a motor and deliver mechanical power when running at a speed of 1,150 revolutions per minute, but it will act as a generator and deliver electrical power if driven at a speed of 1,250 revolutions per minute.

The division of load between two synchronous generators operating in parallel is determined by the fact that their speeds must be such as to make their frequencies equal. The division of load between an induction generator and a synchronous generator which are operating in parallel is determined by the fact that the induction machine must be driven at a certain per cent above its synchronous speed for a given output. Synchronous speed is determined by the frequency of the synchronous generator. The application of this principle and the data regarding the speed-load characteristics of the prime mover will enable us to determine how a given load will divide between the generators.

For an output of 800 kilowatts the slip must be

$$s=800\times 0.018/1,000$$
$$=0.0144.$$

The actual speed of the induction generator is determined by the speed-load characteristic of its prime mover. The speed falls two revolutions per minute from no load to full load, so that for the given output it must be

$$N=254-800\times 2/1,000$$
$$=252.4 \text{ revolutions per minute.}$$

This speed is 1.44 per cent greater than synchronous speed, which must be

$$N_s=252.4/1.0144$$
$$=248.8 \text{ revolutions per minute.}$$

Since the induction generator is wound for 12 poles, the frequency for which its synchronous speed is 248.8 revolutions per minute is

by [41a] $f=12\times 248.8/120$
$=24.88$ cycles.

The frequency of the synchronous generator must therefore be 24.88 cycles. The power delivered by it is

$$P=1,500\times(25.3-24.88)/(25.3-24.8)$$
$$=1,260 \text{ kilowatts.}$$

Answer to Question b.

When a load of 2,500 kilowatts is divided properly between them, the induction generator must deliver 1,000 kilowatts and the synchronous generator, 1,500 kilowatts. At present the frequency of the latter is 24.8 cycles when this load is delivered. Therefore the speed-load characteristic of the synchronous generator must be raised until the full-load frequency is 25 cycles. The synchronous speed of the induction generator for this frequency is

by [41a] $N_s=120\times 25/12$
$=250$ revolutions per minute.

Since the generator is to deliver its full load of 1,000 kilowatts, its actual speed must be 1.8 per cent greater than this.

$$N=1.018\times 250$$
$$=254.5 \text{ revolutions per minute.}$$

Therefore the speed-load characteristic of the induction generator must be raised so that the full-load speed is 254.5 revolutions per minute.

Part II. Answer to Question a.

Under the assumptions here given the power delivered by an induction generator is

$$P=sV^2/r.$$

V is the line voltage and r is the equivalent single-phase resistance of the rotor winding referred to the stator. In this case

$$P=s\times 6,400^2/0.47$$
$$=87,300,000s.$$

If they are to divide a load of 4,000 kilowatts properly, each one should deliver 2,000 kilowatts. For a frequency of 25 cycles the speed of the synchronous generator is

by [41a] $N_1=120\times 25/4$
$=750$ revolutions per minute.

At this frequency the synchronous speed of the induction generator is

$$N_s=120\times 25/6$$
$$=500 \text{ revolutions per minute.}$$

If the induction generator is to deliver 2,000 kilowatts, its slip must be

$$s=2,000,000/87,300,000$$

$=0.0229.$

The actual speed must be

$N_2=1.0229\times500$

$=511.5$ revolutions per minute.

Answer to Question b.

If the full-load frequency is 25 cycles and there is a drop of 2 per cent from no load to full load, the no-load frequency is

$25/0.98=25.51$ cycles.

The load that the alternator delivers for any value of the frequency, f, is

$P_1=(25.51-f)2{,}000/0.51$ kilowatts.

The load that the induction generator delivers for any value of the slip, s, is

$P_2=83{,}700s$ kilowatts.

Synchronous speed for the induction generator is

$N_s=120f/6$

$=20f.$

The slip is

$s=(511.5-20f)/20f.$

Thus

$P_2=83{,}700(511.5-20f)/20f$ kilowatts.

Since the total load delivered is 2,000 kilowatts

$P_1+P_2=2{,}000$

$(25.51-f)2{,}000/0.51$

$+83{,}700(511.5-20f)/20f=2{,}000.$

Or

$(100{,}000-3{,}920f)+(2{,}140{,}000/f-83{,}700)=2{,}000.$

This reduces to

$f^2-3.65f-546=0.$

Solving this equation by the quadratic formula gives

$f=25.25$ cycles.

Substituting this value of the frequency in the expressions for the outputs of the two generators gives

$P_1=1{,}020$ kilowatts

and $P_2=1{,}080$ kilowatts.

These add up to 100 kilowatts in excess of the total power delivered. The reason is that it is not possible on a slide rule to solve the equation for f accurately enough. The division of the load is very sensitive to a change in the frequency. From the equation for the power delivered by the synchronous generator it is seen that a change of 0.01 cycle produces a change of about 40 kilowatts in the output.

DIRECT CURRENTS.

Problem 34.

A direct-current milliammeter has a resistance of 3 ohms and is designed for a full-scale deflection with a current of 25 milliamperes. (*a*) What resistance must be connected in parallel with the milliammeter so that a full-scale deflection of the needle will indicate 50 amperes? (*b*) How much power will be absorbed by the resulting ammeter at full-scale deflection? (*c*) How much current would this ammeter take if connected across a 115-volt line? (*d*) What resistance must be connected in series with the milliammeter so that full-scale deflection of the needle will indicate 150 volts? (*e*) How much power will be absorbed by the resulting voltmeter when connected across a 115-volt line? (*f*) At what point on the series resistance should a tap be located so that a full-scale deflection of the needle will indicate 15 volts? (*g*) If the 150-volt voltmeter is connected in series with a 20-ohm lamp load across a 115-volt line, how much current will the voltmeter take from the line?

This problem illustrates the difference between a direct-current voltmeter and ammeter.

ALTERNATING CURRENTS.

Problem 84.

A three-phase, 25-cycle, 6,400-volt induction generator has a full-load capacity of 2,000 kilowatts. It is wound for 36 poles. The true resistances of the stator and rotor windings at 25 degrees centigrade when measured between terminals, are 0.558 and 0.0760 ohm, respectively. The ratio of transformation is 6,400 to 2,068 volts. The data taken at no load and with the rotor blocked are given in the following table. The temperature is 25 degrees centigrade:

No load	Line voltage	6,400
	Line current	90
	Power	47,800
Rotor blocked	Line voltage	2,160
	Line current	366
	Power	374,000

Assume that the ratio of effective to true resistance is the same for the rotor as for the stator at a temperature of 25 degrees centigrade. Assume that the running temperature is 80 degrees.

(*a*) What is the approximate value of the slip when this generator delivers its rated load? (*b*) What are the output, the efficiency and the power-factor when this generator is operating at a slip of 2.37 per cent?

This problem illustrates the method of calculating the performance of an induction generator.

Answers to the above problems and two new problems will appear in the next issue.

Civil Service Examination for Electrical Expert Aid.

The United States Civil Service Commission announces an examination for electrical expert aid (ship) on May 12, at the usual places, to fill a vacancy in the department of construction and repair, Navy Yard, Washington, D. C., at a salary of $4 per diem, and other vacancies as they may occur requiring similar qualifications at any United States navy yard or naval establishment.

Competitors will be examined in the following subjects, which will have the relative weights indicated: Mathematics and materials, 20; practical questions in electricity, 30; technical education and experience, 50. The duties of this position require a theoretical knowledge of all kinds of electrical apparatus used on board naval vessels, capability of preparing specifications and requisitions for electrical material for ships undergoing construction and repairs, making of tests of electrical auxiliaries in use on shipboard, and of estimating the time, material, and cost of making repairs of electrical equipment on ships.

Applicants should have a general knowledge of the laws of electricity and magnetism, and a practical knowledge of the design, construction, and testing of dynamos, motors, electrical instruments, material, and electrical auxiliaries used in the distribution and application of electric power on naval vessels, and compiling the results of such tests. Applicants must be 23 years of age or over.

Motor Control in Steel Mills Discussed at Pittsburgh.

Industrial Power Meeting of American Institute of Electrical Engineers.

The 308th meeting of the American Institute of Electrical Engineers was held at the Fort Pitt Hotel, Pittsburgh, Pa., April 15-16, 1915. The meeting was called to order on Thursday morning by J. W. Welsh, chairman of the Pittsburgh Section. In the absence of President Lincoln, who was indisposed, David B. Rushmore, chairman of the Industrial Power Committee, which committee had arranged the program for the meeting, presided.

Mr. Rushmore outlined the great progress which has been made in electric power installations in various industries, until now this part of the business of the companies supplying electric current in the cities of the country has assumed a very large proportion. Because of the spread of the use of electric power, the profession of electrical engineering is now divided into a number of branches, such as those relating to transportation, communication, industrial power or motor application, etc. The underlying object of the greater part of human activity is to procure and transport raw materials and then to transform them into commodities for general consumption. In this transportation and transformation electric power plays a most conspicuous and increasingly prominent part in all lines of human endeavor.

The secretary of the Institute, F. L. Hutchinson, addressed the meeting briefly concerning the activities of the Institute.

A. G. Pierce, who had active charge of the preparation of the program for the meeting, stated that what was desired particularly was to make the discussion at the meeting constructive, and that at each of the sessions certain general topics were to be considered: industrial control in the foundry; direct-current control in the steel mill, except hoisting; the direct-current hoist controller; and alternating-current control problems.

R. H. McLain then presented a paper on "Industrial Control in the Foundry."

Industrial Control in the Foundry.

Most of the control devices which are required in a foundry do not differ very materially in their functions from control devices in other industries. However, they have to encounter an unusual degree of dirt. Proper inclosing cases and the latest types of safety protection are advantageous. The crane requires a special kind of control. The difference between alternating-current control and direct-current control is discussed and it is shown that for most cases, where cranes are properly selected and arranged, there is no need of converting alternating current into direct current to accomodate foundry cranes. For maximum hook speed of 15 feet per minute and less, ordinary rheostatic controllers are practically always suitable without very special precautions being taken to adapt them for foundry service. For maximum hook speeds above 15 feet per minute, it is sometimes necessary to use special arrangements. On direct current, a convenient method is to use a shunting resistance across the armature for obtaining creeping speed. For alternating current, it is necessary to provide a large number of controller points and sufficient resistance to reduce the torque at starting to about 25 per cent of normal torque. While it is true that direct current gives a nicer and more convenient control for creeping speeds, yet alternating current provides good enough control for practically all cases.

H. S. Newlin, in opening the discussion, said that in no other line of the metal arts is the simplicity and safety of the equipment so important as in the foundry. Conditions in the foundry are such that the controlling elements must be fool-proof, with the removal of the human element as far as possible. This is obtained by means of the magnetic switch. This type of control is possible on every stationary unit of equipment, whether using alternating or direct current, continuous or intermittent service. In his opinion, the lifting magnet has proven one of the most essential labor-saving devices about the foundry, yet the installation of the magnet means nothing if the proper controlling elements are not correctly designed and of liberal proportions. With reference to the crane, while the alternating-current motor is an ideal one for crane operation, this type has not been accepted as standard equipment in steel mills and until its adoption in the steel mills he did not think it would be introduced into the foundry. The practice of the day is to utilize the jib crane with pneumatic hoist for all the floor work, such as drawing patterns and handling flasks and molds to and from the molding machines, with the large, speedy cranes to handle spotting of molds, pouring, taking out and transferring castings. Dynamic braking is becoming general on all types of direct-current cranes, and its purpose and dependability are familiar to all. Accurate lowering speeds, essential in closing large molds, has become possible only through the use of dynamic braking. He would advocate the installation in all cases of magnetic control systems, and although the initial investment is higher, the lower cost of maintenance and the element of safety will easily cover the additional outlay.

T. E. Tynes stated that his company was equipping the cranes with automatic control as fast as possible. Experience showed that it was a wise thing to do, not only from the standpoint of safety, but of maintenance costs. With automatic braking they could secure slow speeds, creeping speeds, and fast speeds, with absolute protection from plugging and severe strains due to careless operation.

Max Hartenheim called attention to the use of the Ward Leonard control where the crane has to run under varying loads at very wide ranges of speed, and where only alternating current is available. In some cases it will be useful to compare this method with that proposed by the author, as the increase in first cost might well be counterbalanced by the additional advantages, especially with increased speed.

Brent Wiley thought that it would be well to give more attention to the control of the trolley. In foundry service some of the cranes are doing very rapid work, in fact there is no service where a crane gets harder work than in the general running practice of a foundry. While it is operated by a small motor that has perhaps better protective features than the larger type of motors, there is no apparatus in service that has been used more than the trolley motor. Tests have been made on 220-volt motors of 75 horsepower capacity, normal amperes about 30, that would be plugged and would be taking a load of something like 120 or 130 amperes. This condition, undoubtedly, could be improved by the proper application of magnetic control, and would not only increase the speed of the crane, by adding to its working capacity, but would also give material protection to the electrical features of the motor itself.

James Farrington stated that there was one weak feature in the automatic control, in the armature circuit opening up or the trolley line burning, and if the operator should fail either to throw his controller off or pull out his switch the load would be dropped. He had overcome that by using a series switch which is operated in series with the field circuit.

S. C. Coey said that in connection with the modern lifting magnet they have less trouble than with any other type of electrical apparatus. The only trouble is in the controller, and the control of lifting magnets is a problem which is not easy of solution. In the matter of arc welding there was one point overlooked quite generally, and that is the effect of the ultra-vio-

let and infra-red rays from the electric arc on the eyes of the operator, which incapacitates the men through very severe headaches. A number of glasses are furnished by optical companies that will prevent this effect. In his opinion, it is wise to have periodical examinations of the men to see what the effect of the arc welder is on the health of the operators. As to crane control, in the bridge and trolley it is possible to get practically as good results with alternating current as can be obtained with direct current, but in the hoist control he believed that the factors favored direct current. This gives a flexibility that is impossible on alternating-current hoists. They have replaced their mechanical brake equipment with a divided power and dynamic-braking hoist control, using two series brakes. In order to overcome the unsafe points of this control, they are installing a double control circuit on the armature circuit of the hoist motor.

Francis J. Burd said that the best arrangement he had heard of is to put a mechanical governor on the main hoist motor and put the contact on the governor in series with the shunt switch to break the line circuit, cutting power off in that way, to set the brake. With reference to crane control, especially as applied to alternating-current hoist motors, he questioned whether a face-plate type of control is more adaptable to alternating crane motors than the drum type, on account of the fact that more points are afforded on the face-plate type than the drum type. Of course, the face-plate type has the objection of being open, with its live part exposed to the operator and to the dust which is always present in a foundry.

C. M. Bartlett described an electric resistance furnace in which the object is three-fold: (1) to obtain a device which will give absolute control of the temperature or the heating in the working chambers; (2) a heating chamber which will give a reducing atmosphere so as to eliminate the losses by oxidation and scaling; and (3) to make the furnace as efficient as possible. The method is to construct the furnace similar to the ordinary oil-fired furnace and line it with a substance which has a negative temperature coefficient. The furnace at first is at a higher voltage than is used in operating at a normal temperature. As the temperature rises more current flows, and if there was a constant supply of voltage the temperature would attain a value which would cause the lining of the furnace to burn out, so the furnace is provided with a transformer having sets of taps on the secondary which will permit adjustment to obtain the voltage constant at the desired temperature.

J. S. O'Donovan asked if there was a way to temper high-speed metal successfully in an electric furnace.

C. M. Bartlett replied that that was more a question of chemistry than it is of electricity. He believed there had been some forms of electric furnace of the bath type used for tempering high-speed steel, but it was claimed that the bath had a chemical reaction upon the steel.

In closing the discussion, Mr. McLain said that when it comes to severe service on lowering, there is no question that dynamic braking is the only thing which will stand up. He knew of numerous installations where alternating current actually had been used with success, but none of these on really severe work. He heartily agreed that magnetic control is the thing to be used in all cases, and the only factor which limits the use of it is the expense. In certain small foundries handling small material, it is hardly worth while to put in magnetic control; the magnetic control would be larger than the crane. A Ward Leonard control gives ideal results, and the only reason it is not used more generally is that it costs more than any other form of control, both for first cost and power consumption.

At the Thursday afternoon session, H. F. Stratton presented a paper on "Mill Controllers," and Charles R. Riker abstracted the paper on "Steel-Mill Controllers from the Operator's Standpoint," by James S. Riggs.

Mill Controllers.

Electric power is largely supplanting all other types of power for steel-mill work, probably on account of its superior controllability. In almost any type of mill control the object is to start, stop and reverse the machine and its load in the shortest space of time, work done at constant speed being of minor importance. This leads to an investigation of the acceleration of motor-driven machines. The ratio gearing between the motor and the machine is one of the important factors influencing the time of starting and stopping the machines. Analysis is made of the effect of gear ratio between motor and machine, and equations are deduced from which can be calculated the best ratio of gearing for quick starting, quick stopping, or quick starting and stopping. While these equations may be used to determine theoretical limitations of speed and acceleration, any deductions drawn from their use must necessarily be modified by practical considerations.

Steel-Mill Controllers From the Operator's Standpoint.

The writer discusses control problems from the operator's standpoint, in connection with bloom-mill and rolling-mill machinery. The most important consideration is that no provision for emergencies can be allowed, and when the ingot or bloom leaves the furnaces for the rolls it must be kept moving until it reaches the cooling beds. Any interruption in this cycle means scrap material and lost time. To fulfill these requirements the equipment must always stand up to the service and be as nearly fool-proof as possible. The full magnetic control meets the above requirements better than any other type. The requirements of the different classes of machinery are tabulated and from this tabulation it is shown that the control can be standardized in four distinct types, one or the other of which will meet all conditions of mill equipment: (1) Full reverse single-speed type. (2) Full reverse multispeed type. (3) Full reverse multispeed type with dynamic braking. (4) Non-reverse push-button type. In conclusion the author points out that the conditions to be met and their solution should be kept as uniform as possible and the aim should be towards simplicity. The expense of duplication would be avoided by standardization of parts, and this would also permit comparison of different makes of apparatus on an equal basis.

A. G. Pierce drew attention to the matter of standardizing referred to in the paper by Mr. Riggs, which is regarded as a very valuable feature. If it were possible to have the steel-mill apparatus standardized in such a way that it would be possible to get the panels so much alike that general uniformity can be secured, it would most certainly result in cheaper first cost, bring about simplicity in manufacture, less cost in upkeep, and certainly simplicity in operation.

Glenn E. Stoltz said that the average speed of a table or machine must be definitely determined, and from tests on similar apparatus the friction load can be assumed. If the apparatus to be driven is a mill table, the motor should be geared to give a speed somewhat above that specified, so that the actual speed desired will be obtained under average operating conditions. When operating the table at constant speed, the motor should run from 20 to 30 per cent above its rated speed, which is equivalent to approximately 60 per cent of its full-load capacity. This permits the motor to run light for a period of time and allows the commutator to polish. If the size of the motor is such that it operates at full load or overload when running a table at constant speed, the motor is not given an opportunity to polish its commutator, which reduces its ability to withstand the peaks without incurring excessive maintenance. Very often too large a motor is selected in order to get quick acceleration. Excessive speed on the table does not necessarily mean greater dispatch in handling the material, as the metal may skid. Although the commutator has an opportunity to polish at this excessive speed, the plugging or braking current is very severe when the motor is reversed at the high speed.

M. A. Whiting remarked that a good many engineers appreciated in a general way a good many of the considerations regarding acceleration and gear ratios, but few of the men who

appreciated these facts in a general way ever analyzed them theoretically. The formulas in the paper by Mr. Stratton covered a large part of the cases which arise on reversing mill machinery, but did not cover all the cases. If the friction is very light compared with the torque during the acceleration period, that is, during the period of cutting out the resistance, the free running speed will, of course, be very much greater than the speed at which the armature resistance acceleration is completed. In this case the speed-time curve can be computed by taking the successive increments of speed, while the motor is accelerating on the series speed characteristic, and computing step by step the increments of time necessary to accelerate from one value of speed to another, plotting these in the form of a curve, for example, with the time horizontal and the speed vertical, and thus a curve is produced in which the area represents the distance. It is an easy matter, having plotted such an acceleration curve for a given gear ratio of motor, driving machinery, etc., to include the retardation.

J. A. Albrecht pointed out that the operations of some mills are entirely too fast as far as handling the steel is concerned. The operator has certain operations to perform before the ingot goes through the mill, and it takes a definite time to do this. The men in the engineering departments are called to reverse the tables probably twice as fast as the men can handle the steel, and the operating men do not take that point into consideration.

Edwin J. Murphy remarked that there was no doubt that much of the apparatus in a mill was either over-motored or under-motored, and that wherever possible the operating men should make calculations to find some rational basis on which they could calculate the power required, and in this way a great deal of unnecessary work and sometimes very costly blunders could be avoided. He remarked that Mr. Riggs seemed to advocate the use of dynamic braking instead of plugging, but he did not suppose that meant for all applications. He presumed in cases where it is desirable to make an accurate stop dynamic braking might be preferable.

R. H. McLain, with reference to Mr. Riggs's paper, advocated the use of a standard coil and constant continuous voltage rather than the application of extra series resistance with the coil. In connection wtih Mr. Stratton's paper, he desired to add the weight of evidence, if there was any one who doubted the advisability of calculating the matter of gearing. He cited some examples to show the necessity for this calculation.

K. A. Pauly said there was a general feeling on the part of practical men against the use of mathematics. He believed it was of prime importance to make calculations in advance of the application of control. He had looked into an application where it was shown conclusively that what appeared to be the slowest operating condition was actually the highest, and the same thing was proven very conclusively at Gary, where the lifting tables were geared for a lower speed and actually operated faster. There has been a tendency in the past to generalize too much, to make assumptions where the facts were not known, and to assume that certain factors which were difficult to compute were negligible.

Jacob F. Motz said that the magnetic switch displaced the manual controller because it was found that the more controllers one man could operate the better could these operations be kept in step with one another, and the fewer number of men who have to act in unison the more accurate will that action become. It was impossible to assemble more than a limited number of manually operated controllers, even though controlling levers were used, about one man, and this being accomplished very easily with the use of magnetic controllers and their masters, there was but one thing to do and that was to use the magnetic controllers. He called attention to the vast difference in gear reduction used to connect the motors to their load, where the load and motor sizes remain the same, and he believed that this would be a good place for the electrical engineers to step in and improve conditions. He believed there were many points concerning the actual make-up of the controllers and the construction of the individual units that go to make up the controller which should be discussed.

S. C. Coey believed there had been more mistakes made in determining the proper gear ratio on mill tables than in any other application of electricity in the iron and steel industry. There were some features not covered in Mr. Stratton's paper, and one was the friction load. He knew of one new mill table which, after it was in operation for a few months, became so well loosened up that the friction load was reduced to such an extent that it was necessary to cut out the last step on the controller and run it on resistance. He agreed with Mr. Riggs concerning the use of a magnetic controller in a large number of cases. There was one place, however, where criticism could be made of it, and that is where two or three different operators use the same master controller at different points in the 24 hours, and it is in connection with the master controllers that the manufacturers have failed more than in any other point. He believed the master controller should be so heavy mechanically that a man cannot break it, and most of the steel mills in the country have designed master controllers of their own simply to get heavy mechanical resistance to abuse. He had found that in automatic control in certain cases they had practically eliminated the upkeep on motors and controllers, though, curious to relate, they had increased trouble on the mechanical end. The only solution that could be suggested that seemed to apply to the case was the fact that with the magnetic controller in most cases there is a much greater first rush of current than is had with the manual.

Paul Caldwell remarked that in connection with the crane hoist on dynamic braking, the dial controller to be successfully operated requires five trolley wires, whereas, the drum controller may be applied to the same work with four trolley wires. In the dial controller by virtue of the fact that the segments are placed one after the other in what may be termed numerical order, it is impossible to get an individual adjustment of the resistance, which can be secured with a drum type of controller. The drum type of controller, therefore, lends itself to a more flexible application for the work than a dial controller does.

T. E. Tynes said there were many hundreds of different types of motors, and he wanted to put in a plea for standardization. Why did not the motor manufacturers, when they got a good thing, stick to it? There is a great expense attendant upon keeping the repair parts in so many different types of motors as were now in use. It meant the tying up of a considerable amount of capital.

K. A. Pauly replied that the fundamental reason for the great variety of motors is the fact that the whole development of the art has taken place in such a comparatively short time that there are still old machines which are inefficient and inadequate to meet the service still in use. That means i most plants there are representatives of all stages of development. The manufacturer desires that the user shall standardize his practice. There is cause for complaint on both sides, but the matter will straighten itself out, in his opinion, when the art is older and there are not so many changes made in motors, as is the case with other methods of drive, such as the steam engine.

W. T. Snyder said that the simple equations given by Mr. Stratton in his paper should be appreciated by operating men and they should learn to use these equations in connection with an ammeter, voltmeter and stop watch.

Operating men are sometimes suspicious of theoretical calculations, but they should not take the stand that they want to disregard them altogether. A lot of good could be done through a committee in reducing the number of different types of motors and other apparatus in use. Any move towards standardization must comprehend all the apparatus, motors, controllers, etc., as no satisfactory results would be obtained by considering only one type of apparatus.

M. A. Whiting referred to the fact that the industry is constantly progressing, and that it was a difficult matter to standardize apparatus.

K. A. Pauly called attention to the fact that in induction motors alone, considering only sizes from 1 to 200 horsepower, there are frequently 15 different capacities which must be designed for five different voltages—making 75 in all; that there are three frequencies, 25, 40 and 60 cycles, raising the number to 225; the speeds will average four principal speeds, making a total of 900, and in turn, considering waterproof, fire-resisting and ordinary insulations, and open, inclosed, and semi-inclosed types, as well as types suitable for cranes, mill and constant rating, with other special ratings, and other subdivisions of types of apparatus, it makes the total about 1,500. He believed that the manufacturers would appreciate suggestions from the users as to where to begin to make the reduction.

H. D. James said that ten years ago it was usually a race between the mechanical man and the electrical man as to adding reserve power on the mill, but in recent years there had been a decided movement toward reducing the speed and voltages to a comparatively few, and the work of standardization would undoubtedly go on from time to time as the art became more stable.

Graham Bright suggested that if the art of steel manufacture was at a standstill, the motor manufacturer could bring out a motor which could be standardized, but the steel mill is being improved right along, and as the manufacturers bring out a motor which will meet a certain set of conditions, the steel-mill operators bring out a new set of conditions which are more severe in many cases, and which make it necessary for the manufacturers to immediately bring out a new motor. The conditions of lack of standardization are caused by the advance in the art, on both sides, which will probably continue for some time.

C. D. Knight recommended that a committee be formed from the members of the American Institute of Electrical Engineers and the Association of Iron and Steel Electrical Engineers, with both manufacturers and operating men on it, to get together to determine just what is necessary on magnetic-control panels and other control devices to meet the requirements. There may be some mistakes made, but in the long run such work would result in some degree of standardization.

A. G. Pierce agreed that a committee should be appointed to consider the matter of standardization, and on his motion a vote was passed by the meeting approving the appointment of a committee of the American Institute of Electrical Engineers to co-operate with a similar committee of the Association of Iron and Steel Electrical Engineers to bring about some concerted action in the matter.

Mr. Stratton then closed the discussion.

President Lincoln presided at the Friday morning session. The paper on "Control of Direct-Current Hoists in Iron and Steel Mills," by E. G. Stoltz and W. O. Lum, was presented by Mr. Stoltz. This was followed by the paper on "Direct-Current Control for Hoisting Equipment in Industrial Plants," by W. T. Snyder.

Control of Direct-Current Hoists in Iron and Steel Mills.

The control problem discussed in this paper is confined entirely to a typical example of a skip hoist. An outline of the conditions existing in the case of this particular application is given in which the load on the hoist is divided into three parts, namely, the friction load, the inertia of moving parts, and the useful work in hoisting the net load. The proper cycle of operations is determined, which in turn determines the required characteristics for the motor and controller which are together considered as a unit. The details of this direct-current skip-hoist control are described and illustrated.

Direct-Current Control for Hoisting Equipment in Industrial Plants.

In selecting a controller for application to various types of mill machinery all the conditions must be considered, such as the class of operator, conditions of location, operation and maintenance, relative importance of reliability, simplicity, cost of repairs, and initial cost. These points are illustrated by three different types of control as applied to a blast-furnace skip hoist, to a high-speed coal hoist, and to a slow-speed ash hoist. In the first case reliability and continuity of operation are imperative, and other requirements are of secondary importance; in the second case, where an ordinary delay does not affect plant operation, questions of simplicity, repairs, maintenance and inital cost can be given more consideration, as continuity of operation is not absolutely essential; in the third case where the operations are performed by unskilled labor the most important requirements are that the controller perform its functions positively, accurately and automatically, and it should be provided with all the necessary protective features to avoid damage to the apparatus controlled.

H. D. James stated that the theoretical calculations in connection with the arcing of electric switches are difficult owing to the many factors which enter into the problem; yet it is the most important item that has to do with the maintenance of the electric contactor. The mechanical construction of a switch is easily analyzed and passed upon by a good mechanical engineer. The question, however, of the life of contact, freedom from freezing and wear on arc, shields and surrounding parts of the switch were still somewhat obscure. It was his opinion that many data on this question are of doubtful value because some of the factors are not available and others are not accurately determined. When the arc is ruptured under oil, the arcing contact receives a deposit which is largely made up of carbon. In many cases this improves the electric contact between the surfaces. The objection to an oil-break switch is the inaccessibility of the parts submerged in oil. When a contactor switch is closed and the contacts first touch, they tend to bound apart, causing a small arc. Although this arc is not nearly so large as the arc at opening the circuit, it may cause much more damage, as the contacts are immediately closed and if any of the metal of the contact becomes fused the contacts will have a tendency to weld together. This fact is often overlooked.

W. C. Kennedy referred to the blast-furnace skip control as being one which has gone through a great deal of development, and he thought that the point brought out in Mr. Snyder's paper that the blast furnace should be designed so that a very accurate speed is not essential is a very good thing. He had in mind two or three furnaces furnished some years ago with automatic control, in which it is not only essential to have an absolutely accurate stop, but, due to the manner in which the bucket was suspended, that stop must be made gradually and the hoisting speed was rather high. He believed the most essential thing in blast-furnace operation is continuity of operation, and that meant safety in the control equipment and in the motor also. He thought the point mentioned in the paper of having the dynamic braking switch closed automatically was a very good point, and it seemed to him that with the variation of load on blast-furnace equipment some means for automatically varying the amount of armature shunt resistance and keeping the flow down relatively constant should be provided. Another point which he thought was desirable for skip-hoist control was some absolute means of shutting off power in case the proper slow-down is not obtained at the right period. An overspeed device is useful in providing this control.

E. H. Martindale referred to the point in Mr. Snyder's paper that cast iron was not desirable for grids, be-

cause of its liability to breakage, and also that mica was not the most suitable substance for installation purposes because of its liability to failure, due to moisture, oil and similar things. He was of the opinion that the user should make recommendations as to what materials should be substituted for those in use, as those in use were the best that the manufacturer had found available.

Paul Caldwell called attention to the fact that when the series contactor was first put on the market there was a strong tendency to operate bridge machines and cranes, not only small industrial cranes, but gantry and ore bridges and larger types of cranes, with series contactor acceleration, with one speed point in either direction. This practice has brought about some complications. A one-point series contactor control will satisfactorily operate a bridge, provided the ultimate speed of the bridge will not be over 50 to 60 feet per minute. Where a bridge is to be run as high as 200 or 300 feet a minute, the acceleration will be too great, and there is a likelihood of loss rather than of gain in the slippage of the cranes on the track. The object of the application of series contactors at one speed is primarily to gain speed, to keep the operator running at the full maximum of his crane at all times, but if there is going to be loss through some element, it is not wise to try it.

R. A. Black stated that the series switch acceleration on hoists had given him some trouble, especially in the building of them. They had a case where the operating department of a plant had installed a 40-ton crane for a certain class of work in the towers where it is required to lift shafts. There was one case where they lifted an 80-ton weight with a 40-ton crane, which is 100 per cent overload, and the automatic control in that case gave them some trouble. If the motors were large enough to properly do the work, the control would be perfectly satisfactory. He thought the type of grid used was very important, and that the grid with the semi-inclosed eye is better than the one with the wholly inclosed eye, because it is much easier to remove the grid and replace it.

J. W. Welsh made the suggestion that the great multiplicity of automatic and protective devices which the modern systems of control have may make it necessary to supplement these by something more simple to insure their satisfactory operation.

J. D. Wright, speaking with reference to the temperature rise, suggested that since 600 degrees centigrade is about dull red heat, 200 degrees rise is not objectionable.

T. E. Tynes referred to the use of coils for intermittent duty or continuous duty, and said it was his experience that the continuous-duty coil is far better than to complicate the system by any external resistance coil in series with the operating coil. During the applications where quick, snappy action is required, a lower-voltage coil would be used in order to get that action, which are few compared with the operations where the standard coil could be used, and he did not believe it was wise to complicate the control equipment by adding various resistance coils in series with the operating coil.

Paul Caldwell said that while the magnetic equipment is more expensive from the standpoint of upkeep and first cost, it was not more expensive or more intricate to operate than a straight brake manual controller would be.

C. A. Dauler asked, if a one or two-point series switch controller is not satisfactory for bridge travel on account of switches locking out and preventing operation or acceleration when the bridge is called upon to handle loads that are unfair and in excess of the work for which the bridge was designed, why will a selective speed controller with series relays and shunt switches be any improvement, as the series relay will, of course, lock out and prevent closure of accelerators and fail to cut out the accelerating resistance the same as the series switch, if the series relays are set at the same closing value as the series switches in order to give the motor the same protection.

Francis J. Burd spoke of the limit switches as being an important part of the equipment. He believed that the limit switch should be positively connected mechanically to the winding drum and contacts ought to be made double-pole and also should be of the air-break type. He also believed that the brake on the hoisting equipment should receive very careful attention, and should be made large, husky and of large peak capacity.

M. A. Whiting remarked in connection with the matter of temperatures on iron grids, that there was room for a closer understanding on the part of purchasers as to what they are calling for when they put out their specifications on rheostats for use with the various classes of control.

E. G. Stoltz, in closing the discussion, said that the overloading of the crane is a matter of poor judgment on the part of the management, and that under such conditions the designer of the control could not be held responsible if the control failed to give the proper degree of satisfaction.

At the Friday afternoon session the first paper on "Alternating-Current Controllers for Steel Mills" was presented by Arthur Simon. This was followed by the paper on "The Alternating-Current Coal Hoist," by Raymond E. Brown.

Alternating-Current Controllers for Steel Mills.

The induction motor with either squirrel cage or wound rotor is practically the only type of alternating-current motor used for general industrial purposes in this country, and therefore the author has confined his paper to considerations of the control problems offered by induction machines. The various types of alternating-current controller in use are described and illustrated and the advantages and disadvantages of each type, as well as its limiting capacities, are discussed. A number of typical examples of installations of alternating-current controllers in mill work and allied industries are described. The advantages of automatic control are brought out. Immersion of rheostats in oil is not recommended. Comparative data are given for electrically operated shovels with and without automatic control. Pumps, conveyors, coal and ore bridges, skip hoists, mine hoists, and rolling mills are separately considered.

The Alternating-Current Coal Hoist.

The paper describes an alternating-current coal hoist recently installed near Pittsburgh, in which dynamic braking is employed. The brakes and clutches are operated by compressed air, which permits of a maximum rate of operation and also makes feasible the use of various safety devices. The electrical equipment of the coal hoist must be capable of continuous operation at the maximum speed and any attempt to insure against motor or brake trouble by providing excess capacity simply results in the motor being operated at that increased capacity. The control in lowering the empty bucket at high speed must be accurate enough so that it can be slowed down quickly without damaging the barges or steamers in landing. With a friction brake the only way to avoid striking too hard in landing is to make a complete stop before reaching the bottom thereby causing an appreciable loss of time, which is entirely avoided by the use of dynamic braking. In the case of the plant described the control has proved sufficiently accurate and exact so that a complete cycle of the hoist trip, due to the overlap of hoisting and racking movements, can be made in 40 seconds instead of the estimated time of 50 seconds.

M. A. Whiting said that where solenoid operation is required, in any case, the question is one between design and cost of solenoid-operated switches and air-break contactors. There are certain cases where the air-break contactors are far more reliable and preferred by the trade. These cases are mine hoists and some other classes of work in which the number of operations per day is very large. In such cases the carbonization of the oil is entirely eliminated by the air-break contactors, the contacts are open to inspection at any time, so that wear can be more easily kept track of, and furthermore, the wear on the tips of air-

break contactors is in many cases less than the wear on the tips of corresponding oil-immersed devices to do the same work. This statement, he said, was at variance with generally accepted ideas, but tests have been made which tend to show that there is a considerable difference in wear in favor of the air-break contactors.

J. A. Albrecht said that with reference to the design of relay acceleration, he believed that the single-phase relay is the simplest form of relay, if you can get it to work satisfactorily. He did not agree with Mr. Whiting in his statement regarding the superiority of the air-break switch over the oil switch, and he said he would also like to emphasize the necessity of putting an oil breaker back of the panel of sufficient ultimate breaking capacity to take care of any short-circuits or any other overloads.

R. H. McLain remarked that the jam relay operates only after the strain has taken place and not before, so it does not really prevent the strain, but prevents a continuation of the strain. After the jam relay operates, there is a flywheel effect in the armature which will carry the hoisting ropes, etc., for a slight distance further, and there is nothing to prevent this except the give in the apparatus, such as the stretching of the rope or slipping of something somewhere.

W. C. Kennedy referred to the point that when the individual acceleration was introduced one of the great points in its favor was that it was possible to set each individual switch at whatever current value was desired. This is particularly true in direct-current practice, because the direct-current motor can commutate much better at a slow speed than it would when nearly up to speed. The same thing now applies to alternating current, where it is possible to adjust each step individually.

C. D. Knight was of the opinion that both the oil and the air-break contactors had each a very decided field, but where very frequent operation is required the air-break type is the only one which can be used successfully.

W. O. Oschmann said that as to the question of the air-break contactor versus the solenoid-operated switch, there is a field in which the solenoid-operated switch is preferable to the air-break contactor. In a case where there were only 20 or 30 operations per day, and it is still expected some time to have reversing service of the motor, by use of the air-break it is found necessary to complicate the control circuit to the extent of providing some method of preventing the reverse contactor from coming in before the arc is interrupted on the main contactor going out. He had a case occur where the arc fell down to such an extent that the incoming contactor closed before the arc was interrupted on the outgoing contactor, thereby producing a short-circuit and throwing the whole system out of order.

Graham Bright referred to interlocks on air-break switches. He had experience in operating a hoist in which the reversal was very quick, and, as has been mentioned, the arc holds long enough to allow the other reverse switch to come in before the current is actually broken. This occurred in a hoist where plugging was used to stop the hoist about once every 2,000 operations. A short-circuit took place which, of course, dropped the voltage on the line, which immediately robbed the motor of its torque, and it was only by the alertness of the operator that a wreck was prevented.

Clark S. Lankton said that very good conditions were obtained with the single-pole relay. When the motor is going up to speed, or at the start, when the motor is at low speed, the frequency will be high enough, so that one gets very good conditions in the relay. When the motor comes nearer to speed the acceleration is much greater, so that the last switches are closed very rapidly as compared to the switches on the low speed, and the reason which occurred to him for the good operation of the single-pole relay is because the relay is not of much use when the motor is nearly up to speed.

E. S. Duck remarked that it would have been very interesting if Mr. Brown had shown the scheme of ropes. He thought that would have a bearing on the whole subject. The question of dynamic-brake control for towers of the kind referred to is of much interest. In working out a dynamic-braking problem, using direct-current motors, the problem is somewhat simple. The characteristics of a direct-current motor are pretty well known, and for different motors are more or less the same, but when alternating-current motors are considered in this connection the characteristics are not likely to be the same at all.

The papers were further discussed by E. G. Stoltz, W. O. Oschmann, John D. Wright and W. F. Detwiler, after which the authors closed.

Among the social features of the convention, there was a joint luncheon on Thursday with the Pittsburgh Jovians. George R. Folds, representing the Jovians, welcomed the company. There were about 250 present. On this occasion Morris Knowles, of Pittsburgh, delivered an address on "The Civic Responsibilities of the Engineer."

After an informal beefsteak dinner on Thursday evening, President P. M. Lincoln spoke on the activities of the Institute. John A. Brashear, of Pittsburgh, delivered an address on "Reminiscences of Scientific Discoveries." There was also an Institute luncheon on Friday, which was very well attended.

Philadelphia Electric Vehicle Meeting.

The regular monthly meeting of the Philadelphia Section of the Electric Vehicle Association of America was held at the Colonnade Hotel on Wednesday, April 14, at 12:30 p. m.

The Membership Committee reported one new member, Harry Evans, proprietor of the Bryn Mawr Garage, at Bryn Mawr, Pa. He is fitting up his establishment to take care of electric cars, with equipment for at least ten cars.

The Traffic Committee reported that it is preparing, in conjunction with other bodies, some recommendations which it is hoped will be adopted for the improvement of traffic conditions.

The Garage Committee reported that the list of charging stations in Philadelphia territory is now ready for distribution. It has been printed by the courtesy of The Philadelphia Electric Company, and copies can be had upon request.

Attention was called to House Bills Nos. 322 and 323 in the Pennsylvania Legislature, which give power to individual towns to make an additional tax on motor-truck users. A motion was passed that the Philadelphia Section of the Electric Vehicle Association wishes to be put on record as opposed to the passage of said bills, and action taken to that end.

The souvenir which was promised to each attendant at this meeting proved to be the Smith & Cushing handbook on "Electric Vehicles," which has had an insert of sixteen pages and a map applying particularly to Philadelphia. This little volume in a flexible leather binding was presented with the compliments of The Philadelphia Electric Company.

At the completion of the routine business, the chairman introduced the speaker of the occasion, B. D. Gray, vice-president and general manager of the Hess-Bright Manufacturing Company, whose paper was entitled "Ball Bearings." Mr. Gray's paper was excellent and complete and without being too technical gave a very detailed account of the progress made in the ball-bearing industry. He called attention to the application of ball bearings in the construction of electric vehicles, told how and why they were used, and what to avoid in the use of improper lubricants. A record of tests and a table of "don'ts" were also given. The paper was illustrated with charts, blueprints, models and specimens which were passed among those present.

LETTER TO THE EDITOR.

Inspection in Small Towns.

To the Editor:

There is a question the writer wishes to have answered through your columns. It is of considerable concern to those engaged in the contracting trade in this and other towns similarly situated. I refer to the question of proper inspection of electric wiring. Under the present condition the situation is equivalent to declaring a certain job safe in a small town and the same identical job unsafe in a large town, a most inconsistent stand for the insurance companies to take, since it appears that they will accept a risk in the smaller towns without questioning the condition of the electric wiring. In this city the writer has known open link fuses used for the main entrance fuses, placed in the show windows of dry goods stores; old, worn out drop cords in show windows, and other conditions which would be promptly condemned in cities where inspection is in force, but which seem to go unnoticed in the smaller towns. An explanation of this situation would be much appreciated. E. M. RAETZ.

Rochester, Minn., April 13, 1915.

Western States in Big Hydroelectric Merger.

The merging of all important hydroelectric power corporations in Utah, Idaho, Colorado and possibly Montana and Washington, into one gigantic company, is said to be the 1915 program of the Electric Bond and Share Company, of New York. Many of the power corporations involved are subsidiaries of the New York company, which has an authorized capitalization of $20,000,000. Among the subsidiaries is the National Sureties Company, also of New York, which is reported to be the intended merging corporation of the hydroelectric companies west of Denver. The program is also said to include the establishment of headquarters in the West, probably in Salt Lake City. It is reported that the Western Colorado Power Company, of Montrose, Colo., the consolidation of power companies of western Colorado, now looks to Salt Lake City and the Utah Power and Light Company for orders. The Colorado concern formerly made its reports to the Electric Bond and Share Company.

The plan of the present parent corporation, it is reported, involves the immediate merging of the three hydroelectric power companies in Boise, Idaho. These include the Idaho-Oregon Light and Power Company, and the Idaho Railway, Light and Power Company. The Southern Idaho Water Power Company, which now operates in what is known as the "Pocatello territory," is reported to have agreed to go into the merger, having signed the preliminary papers at a recent conference held in New York.

As soon as the contracts of the Great Shoshone and Twin Falls Water Power Company can be straightened out that corporation also will be taken over. The Utah Power and Light Company, to which was recently sold the Utah Light and Railway Company, (the latter afterwards being renamed the Utah Light and Traction Company) is already controlled by the Electric Bond and Share Company.

The merger, so far as it has already been completed, includes all of the hydroelectric power companies of consequence in Southern Idaho, Utah and western Colorado. The Electric Bond and Share Company also has plans under way and hopes to acquire holdings of the Washington Water Power Company, one of the largest electrical corporations operating in the Northwest and at present independent.

The Southern Idaho Water Power Company, and the Great Shoshone and Twin Falls Water Power Company, formerly Kuhn enterprises, are now controlled by the American Waterworks and Electric Company, of New York. The two companies are in control of the Pocatello and Twin Falls territories.

Recently the public utilities commission of Idaho permitted the Idaho Power and Light Company to enter the Twin Falls field, but that concern had practically ceased construction work there and large crews of men were laid off. The company, however, is included in the new merger, a plan which eliminates competition in that territory.

Electrical Show at University of Illinois.

The electrical engineering students at the University of Illinois held, on April 8 to 10, their fifth electrical show. It has been the custom to give a show at the university once in two or three years. The space available this year in the old Armory and in the Electrical Building at Urbana, Ill., made it possible to give an exhibition on a much larger scale than ever before. In November the students organized for work. It was in every respect a student enterprise and the students deserve great credit for effectively carrying out so great an undertaking. Many students spent their spring recess in the preparation of exhibits for the show.

There were a good number of commercial exhibits of motors, fans, lamps, small isolated electric plants, automobiles, and other electrical apparatus. The students arranged spectacular demonstrations of high-voltage discharge from a 200,000-volt transformer and from a giant Tesla coil yielding sparks eight feet long. These created great amazement among the spectators.

In a dark room discharges in vacuum tubes varying in length from a few inches up to ten feet afforded an opportunity to note phenomena seldom seen outside the laboratories of research investigators. One of the most elaborate exhibits was a representation of the Panama Canal. This occupied a space 70 feet in length and was complete with locks, electric towing locomotive and electric lights. A miniature railway with electrically operated train, controlled by automatic block signals attracted much attention. Another special feature was the starting of an automobile by means of wireless.

Loud-speaking telephones were operated at busy corners in the city a mile away. This afforded a most effective method of advertising the show. It was found that under favorable conditions these telephones might be heard as far as 1,000 feet from the receivers.

The attendance during the three evenings and one afternoon was about 6,000. The students have received many compliments on the excellence of their undertaking.

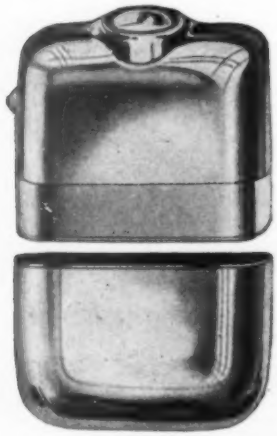
Among electrical manufacturers and dealers who exhibited at the show were: American Ironing Machine Company, Caldwell Electric Company, Century Electric Company, Chelten Electric Company, Chicago Fuse Manufacturing Company, Commonwealth Edison Company, Cooper Hewitt Electric Company, Cutter Electrical and Manufacturing Company, Delta-Star Electric Company, Edison Lamp Works, Electric Appliance Company, Electric Storage Battery Company, Eureka Vacuum Cleaner Company, G. & W. Electric Specialty Company, General Electric Company, Hurley Machine Company, Ideal Electric Company, Lewis Electric Supply Company, Lincoln Electric Company, Line Material Company, Manhattan Electrical Supply Company, Meadows Manufacturing Company, Moloney Electric Company, National Carbon Company, National Lamp Works, Nungesser Carbon & Battery Company, Petschel Storage Battery Company, Pyrene Company of Illinois, Reliable Electric Company, Sangamo Electric Company, Schweitzer & Conrad, Incorporated, Swartz Electric Shop, Thomas G. Grier Company, Twin City Electric Company, Urbana Light, Heat & Power Company, Walker & Mulliken, Westinghouse Electric & Manfacturing Company, Zinke Company.

New Electrical and Mechanical Appliances

New Telescope Case for Pocket Flashlight.

A new and neat design in metal vest-pocket flashlights is the Kwiklite telescope case illustrated herewith. The faults of previous flashlight cases have been overcome in this attractive new design, which consist of two parts drawn into shape from a solid sheet of metal, the upper part telescoping into the lower; when pushed together, the two parts firmly lock. With a slight pressure on the side of the case, however, the two pieces can be pulled apart again, making it an easy matter to insert the battery.

There is no hinge on the entire case and no clasps which easily catch and tear the pocket. The cases are of pleasing design and fine finish. They are supplied in a variety of beautiful finishes, including nickel, gun metal, statuary bronze, silver and gold. This case is one of the many new and original designs in flashlight products placed on the market by the Usona Manufacturing Company, Inc., 1 Hudson Street, New York City, and 307 South St. Clair Street, Toledo, O.



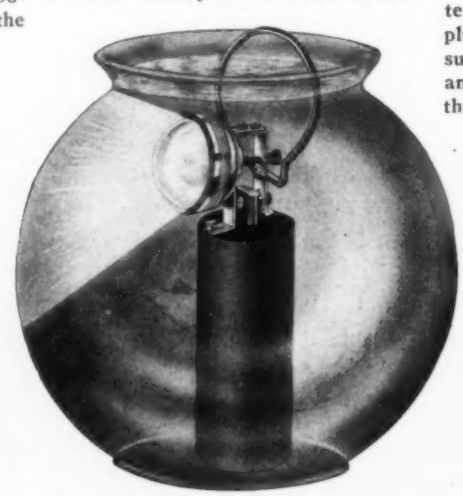
Telescoping Flashlight Case.

New Form of Dry-Cell Lighting Attachment.

The very rapid increase in the use of electric lanterns operated by means of single dry cells is responsible for the introduction from time to time of new types of these equipments. Among manufacturers who have met with exceptional success in the development and production of such electric lanterns is the Central Telephone & Electric Company, St. Louis, Mo., whose Pract-el-lite electric hand lantern was described in these columns a few months ago. This lantern consists of a casing containing a single dry cell and provided with two handles for carrying it and a powerful reflector and lens combination for projecting the light to a great distance.

Lamp Attachment for Dry Cell.

A simplified form of this Pract-el-lite outfit has recently been added to the company's products. As shown in the accompanying illustration, it can be attached directly to the dry-cell terminals. The outfit is strongly made and so designed that it can be connected to the cell very quickly. A bail handle affords convenient means for carrying the complete unit. The lamp, reflector and lens arrangement is similar to that used in the somewhat more expensive type of hand lantern. An efficient tungsten lamp, together with the well designed reflector and lens, affords a combination that throws a powerful beam of light a long distance.



Pract-el-lite Operating Submerged in Water.

The company has placed this outfit complete with battery in a jar of water so that it is completely immersed without appreciably affecting its operation. This test was made to show that the equipment is not affected by even the most severe weather conditions. In this connection a suggestion has been made that it can be hung on a chain and dropped into a river to attract fish to the light.

New Type of Attachment Plug.

A unique idea is embodied in the new type of attachment plug recently placed on the market under the trade name Arroplug. As shown in the illustration, instead of having the usual outer screw shell with many threads it has a cylindrical shell with short thread. This permits connection of the plug by merely inserting it in the socket or receptacle and giving it about one turn to the right. The center contact is mounted on a spring plunger which exerts sufficient pressure to hold the plug firmly in place and in such good electrical contact that its rating is 660 watts, 250 volts.

Arroplug.

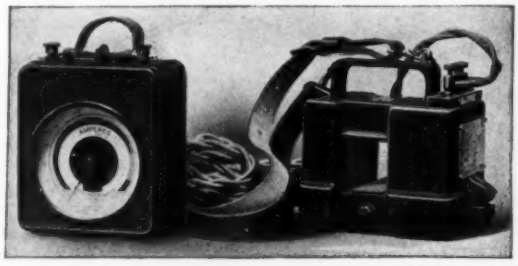
The plug does not loosen from vibration, but can be very quickly removed by a turn to the left which breaks the circuit instantly without arcing.

For wiring the plug, the interior is removed by depressing a small flat spring by means of a screw-driver, knife or similar tool. After wiring, the interior is put back into the shell and snap-locked automatically. The plug is insulated with Thermopflax, an insulating compound that does not

soften or burn at even 600 degrees Fahrenheit. The entire plug is of simple and durable construction. Its use is particularly advantageous in connection with all kinds of electrical appliances that are connected and disconnected frequently. These plugs are made by the Arrow Electric Company, Hartford, Conn.

Portable Alternating-Current Ammeter and Current Transformer for Use on Cables.

There are many uses in central-station work for a high-grade portable alternating-current testing outfit that combines accuracy and lightness with low first cost, and which permits measurement of current in cables without interfering with them. Such an outfit with a capacity of 75 to 250 amperes is now offered by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The transformer is so constructed that it can be clamped around any cable or feeder without opening the circuit, and therefore has a wide field of usefulness in testing cables in the power house, in manholes or on the line.



Cable-Current Measuring Set; Ammeter, Transformer and Connections.

Current Transformer Open for Embracing Cable.

The standard outfit consists of a portable split-type current transformer, a type PR portable ammeter, a set of leads 10 feet long and a strong leather carrying strap. The total weight of the outfit is less than 30 pounds.

The split-type current transformer is made with a clamp at one end and a hinged joint at the other so that the two halves can be opened up, slipped over the cable, and clamped together tightly. The use of this transformer obviates the necessity of opening the main circuit or of cutting the cable to make a test. By means of binding-posts on the transformer, connections can be made for obtaining full-scale readings of either 125 or 250 amperes.

New Hubbell Shade-Holder.

To the extensive line of shade-holders made by the firm of Harvey Hubbell, Incorporated, Bridgeport, Conn., has been added a new type known as No. 6244. This is a 2.25-inch holder fitted with the standard Hubbell contractile collar which insures both rigidity and central suspension. The holder has a deep curved skirt which allows ample neck room for any type of shade or reflector. This holder is furnished in the various standard fixture finishes and can also be supplied in special finishes for particular requirements.

New Shade-Holder.

Unique Motor-Generator Set.

A very novel and interesting motor-generator set equipped with a Merrill regulator has recently been built and installed for use with electrolytic cells for generating oxygen gas used in oxy-acetylene welding. The set of cells with which the motor-generator is being used operates most efficiently at 400 amperes and 190 volts. There was available 220 volts direct current from the central-station supply mains. Under ordinary circumstances it would be necessary either to waste the difference between the 190 volts required and the voltage of the power circuit in a resistance or to purchase a 76-kilowatt motor-generator set consisting of a 230-volt motor and a 190-volt 400-ampere generator.

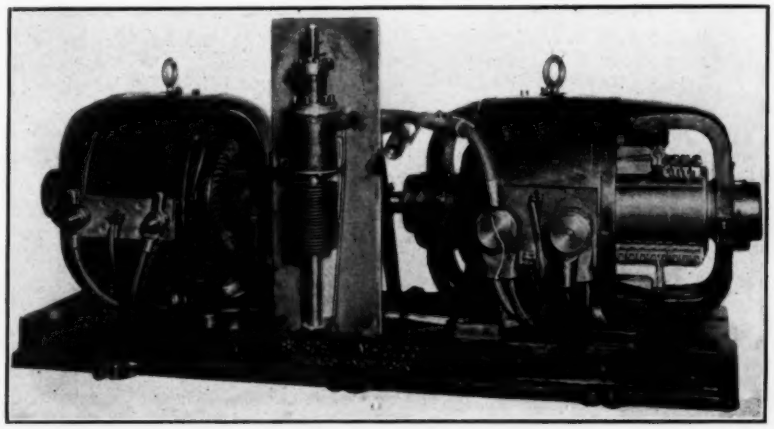
By properly designing the motor-generator set and using a specially designed negative regulator, it was possible to use a 13-kilowatt motor-generator set. This effected a saving of about $1,000 in the first cost and will save about $500 per year in operating cost.

The motor of the set is designed to carry 400 amperes and is placed in series with the gas-producing cells across the 220-volt mains. In other words the motor consumes only about 30 volts, leaving the 190 volts required by the gas-producing cells. The power developed by this motor is used to drive a 220-volt generator feeding current back into the 220-volt mains. The regulator is so arranged that it operates on the motor field to maintain a constant current of 400 amperes through the motor and electrolytic cells.

Since this motor-generator set has a capacity of 13 kilowatts instead of 76, not only is the first cost very much less than that of the larger set, but a much better total efficiency on the complete installation is also obtained. An ordinary 76-kilowatt motor-generator set would have an efficiency in the neighborhood of 81 per cent. With the outfit described a total efficiency of approximately 95 per cent was obtained. Of course, the efficiency of the 13-kilowatt motor-generator set itself was less than 81 per cent, but the total losses in the set (due to the fact that it is only about one-sixth as large) are very much less. They are, in fact, only about five per cent of the total power taken from the central-station lines. This makes the operating efficiency of the installation 95 per cent.

This same style of motor-generator set can be used efficiently and with similar savings in any case where it is desired to get a secondary direct-current voltage anywhere between 50 and 100 per cent of the supply-line voltage. This is often desired, especially in charging storage batteries, and by properly proportioning the regulator a tapered charge can be obtained with the set.

In the smaller sizes particularly, there might not be much saving in the first



Unique Motor-Generator Manufactured by Roth Brothers & Company.

cost, due to the additional cost of the regulator. There would, however, be a decided saving in operating cost. The set described above has been in operation now for several months and is giving entire satisfaction. It was designed and manufactured by Roth Brothers & Company, Adams and Loomis Streets, Chicago, Ill.

Pagrip Metal Molding and Fittings Therefor.

A new type of metal molding of unique construction and with a complete line of appropriate fittings therefor has been developed and placed on the market by O. M. Pague, 226 North Jefferson Street, Chicago, Ill. This type of molding has been given the trade name of Pagrip. In the design of this material it was aimed to secure a very simple but rigid and durable construction, and one that would permit easy installation and ready adaptation to standard fixtures.

Fig. 1.—Molding with Capping and Wires in Place.

A fair idea of the construction of this molding is obtainable from Fig. 1, which shows a short piece with the relative position of capping and wires made clear. The other cuts show various fittings for use with this molding. The body of the molding is an open-top channel with an internal width of 25/32 inch and a depth of 9/32 inch.

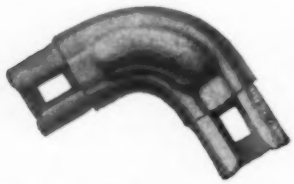


Fig. 2.—Elbow Fitting for Molding.

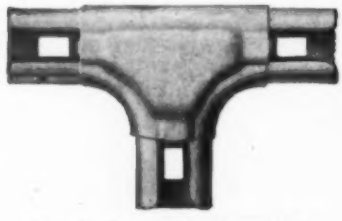


Fig. 3.—Tee or Branch Fitting.

The upper portion of the channel has its sides brought together and curved upward, leaving a narrow opening for the reception of the capping. The latter is also in channel form, with the edges flanged outward. This capping can be readily inserted in the open top of the base, after the wires have been placed in the molding, by merely pressing the capping in until the flanged edges of the capping engage the edges of the base. Since both the base and cap are made of spring steel the cap is gripped in place and rigidly held. However, should it be necessary to remove the capping again, it can be done by applying sufficient pull. After the capping has been put on, the molding has a neat, finished appearance, its grooved face giving the aspect of a simple ornamental molding.

Fig. 4.—Pagrip Cross Fitting.

Joints of adjacent sections of molding are formed by merely slipping together adjoining ends, the elasticity of the sides permitting a good mechanical and electrical joint to be made; no screw connection is required. This method of forming joints results in a saving of 25 per cent in installation cost, according to the claim of the manufacturer, since only one man is required to install the molding, wire and fittings in perfect condition, regardless of the length of run. As soon as the base is mounted on the ceiling or walls by means of a simple type of clip, the wire can be laid into the channel and a cover put on in very short time.

Fig. 5.—Junction-Box Base.

Fig. 6.—Large Fixture Box.

In tests of this molding it was found that a pull of about 30 pounds was required to open the joints. Current was also applied to a run of some 20 feet of molding in which were inserted a large number of fittings, making a total of 27 joints, the idea being to see whether the material itself afforded a good path for grounding of the molding. Although a current of 15 amperes was applied, after two hours no appreciable temperature rise was noticeable at any joint. In handling the entire run of molding with fittings referred to, the entire arrangement showed a strength and rigidity about equal to that of a solid piece of molding, no loosening or buckling of joints being noted.

Fig. 7.—Box for Snap Switches and Fixtures.

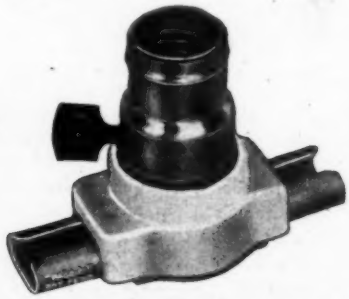


Fig. 8.—Two-Way Base and Cap for Standard Receptacles.

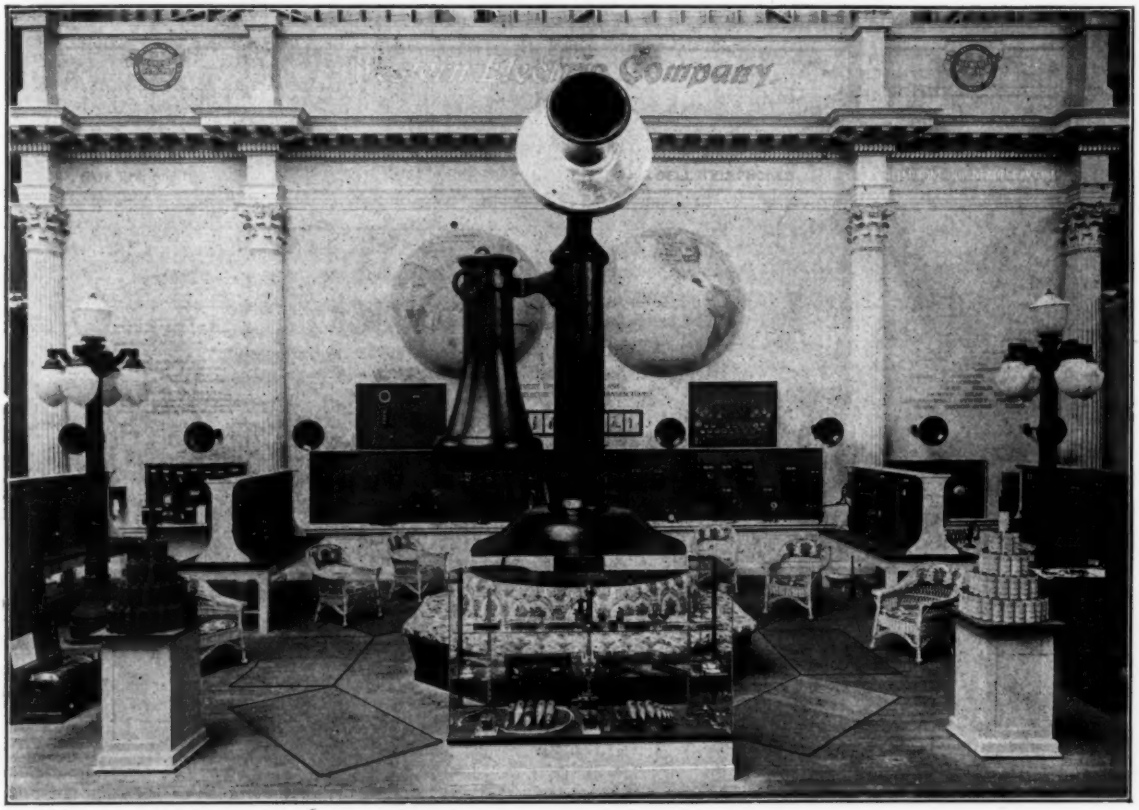
In the line of fittings that has been developed for use with this molding there has been designed a complete assortment, of which the accompanying illustrations give an idea. It will be observed that in the case of elbows, tees, crosses, etc. (Figs. 2, 3, 4 and 5) the connecting ends are C-shaped in cross section. These ends telescope over the end of the molding base a distance of 1.125 inches, a small lug or stop being provided near the end of the molding for this purpose. This lug fits into the rectangular pocket shown in the connecting ends of the fittings,

Fig. 9.—Connector for Joining Molding and Boxes.

thus locking the joint securely. The caps for the fittings fit over the extension and are held in place by spring action. A tongue on the cap fits into the groove in the capping of the molding.

Among the fittings is an ingenious junction-box base, Fig. 5, which can be used with appropriate covers as a plain junction box, as an outlet for drop cord, as a fixture base for mounting snap switches, rosettes, etc. A large fixture box, Fig. 6, can be used with the molding for any standard four-inch canopy, blank or fixture covers. When used for mounting snap switches, fixture sockets or receptacles, another type of cover, Fig. 7, with slots for two screws is used. Fig. 8 shows a receptacle standard key or keyless type mounted on the base; this can be used in connection with one-way or two-way fittings. All of the various boxes and covers are provided with lateral knockouts, so as to fit the conditions. A very simple form of connector is used for joining a straight run of molding to any standard box. The lateral knockout is broken away and the connector slipped on from below, so that the notches engage the sides of the opening in the box.

The molding is made of especially selected steel of high elasticity. It is then sheradized both inside and outside, as also are all of the fittings. This insures against corrosion and makes for good electrical connections between the different sections of molding and fittings, so that when the entire installation is grounded a satisfactory arrangement is secured. The area and pressure existing at the joints are such as compare favorably in conductivity with contacts obtained in knife switches. The contact surface of the heavily zinc-coated joints is approximately two square inches, and the manner in which these are assembled by a sliding action secures a clean wiped contact. This typ of molding and the fittings for it have been approved by the Underwriters' Laboratories, Incorporated.



Center of Western Electric Company's San Francisco Exhibit Booth, Showing Telephone Display.

Western Electric Exhibit at the Panama-Pacific International Exposition.

A gigantic desk telephone, 15 times the size of the familiar instrument of everyday use is the central figure of the Western Electric Company's exhibit at the Panama-Pacific International Exposition, San Francisco, Cal.

The architecture of the booth, which covers a floor area of 3,000 square feet, is different from the usual type. The central section is open overhead, and on the back facade, in addition to a list of the 49 cities throughout the world in which the Western Electric Company maintains offices, and a list of its principal classes of products, are large reproductions of the eastern and western hemispheres on which these 49 principal cities are marked with miniature electric lamps which flash every 12 seconds, this being the present rate at which a telephone is turned out from the company's main works, Hawthorne, Chicago.

The large desk telephone, mentioned as forming the central figure of the booth, has built around its base a comfortable and luxuriously upholstered seat or lounge for the convenience and comfort of guests.

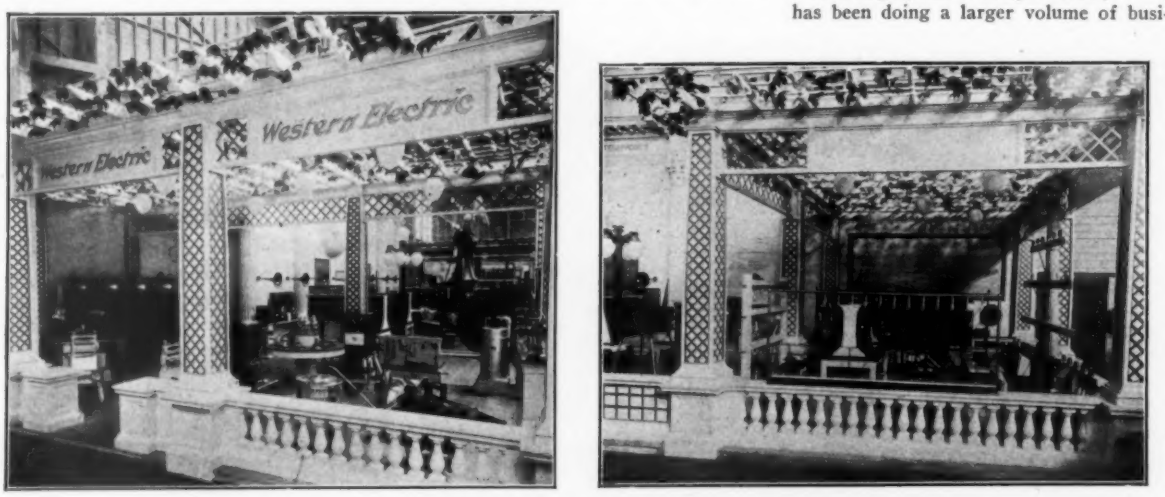
At either side of the central section, the booth takes the form of pergolas in which various specialties are exhibited. The color scheme is cream with green lattiee work on the pergolas.

Prominent in the specialty exhibit are vacuum cleaners ranging from a small cleaner, designed for use in apartments or a small house and which the housewife can hang away on a hook in the closet when she has finished the morning cleaning, to large stationary cleaners for use in hotels, office buildings, large residences, department stores, etc. There are also electric washing and wringing machines; electric ranges in and on which

the baking, boiling, frying, etc., of the small family or the largest restaurant can be easily, quickly and economically done; electric irons, toasters and other cooking utensils; Sunbeam Mazda lamps in all conceivable shapes and candlepowers; also electric motors and electric lighting plants all completely contained on one base and intended for the farm or residence out of reach of the city or town electric wires. In addition to these specialties there are many others, such as electric fans, electric dishwashing machines, bells, annunciators, pole-line material, etc.

In the telephone section of the booth there is a large and comprehensive display of telephone equipment, for which the company is especially noted, including telephone apparatus for dispatching railway trains, for use in mines, in regular exchange service and also for intercommunicating or private telephone systems; also, telephone switchboards of different styles and sizes and adapted for different classes of service.

One of the special features of this exhibit is a practical demonstration of the company's recently perfected loud-speaking telephone equipment which is particularly adapted for announcing in railway stations, announcing in baseball parks, paging guests in hotels, etc. Eight of these instruments are installed in the booth.



Portions of Western Electric Exhibit, Showing Household and Miscellaneous Appliances.

A New Form of Primary Battery.

A new form of primary battery was described last year in *La Lumiere Electrique* by E. Bellini. In this battery the negative electrode is an amalgam of lead, consisting of one part by weight of mercury to nine parts of lead. The positive electrode is carbon. The electrolyte is a mixture of sulphuric and nitric acids.

The electromotive force is 1.25 volts. Internal resistance in the battery increases with the current, and in the form made up by the author, the value is about 0.1 ohm for two amperes. In this case the negative electrode had a surface of 200 square centimeters, with a positive electrode on each side at a distance of two centimeters.

During the operation of the battery a white flocculent precipitate is deposited in the bottom of the cell. This is made up of lead sulphate, mercurous sulphate, and tiny globules of metallic mercury. Gas is given off from the positive electrode. This gas consists largely of nitrogen, with a small quantity of oxygen and only a trace of hydrogen. The electromotive force in the battery increases very slightly at first, and then diminishes gradually as the electrolyte becomes exhausted. The battery may be regenerated by the addition of acid.

The object sought in devising this battery was to avoid the use of a porous jar and at the same time avoid the contamination of the electrolyte by compounds formed at the electrodes. As the sulphates formed in this battery are insoluble, they fall to the bottom and do not interfere with the action of the electrolyte.

Reorganization of The United States Light & Heating Company Assured.

In the proceedings before Judge Hazel of the United States District Court of the Western District of New York in Buffalo on March 30, the receivers announced to the court that a complete reorganization of The United States Light & Heating Company is now assured through the efforts of the Stockholders' Protective Committee. It appears that the latter represent over $2,000,000 of the $2,500,000 outstanding preferred stock and about $6,000,000 common stock, giving them the majority control.

The application of the receivers was for the purpose of advising Judge Hazel to wind up the receivership and transfer the business and the property to the reorganized company. It is understood that necessary notification to the stockholders and others will take some little time and it appears, therefore, that the receivership will be discontinued some time in June.

In the meantime, the business will be conducted without interruption under the same operating management as heretofore, and the prospect for a large volume of business seems unusually bright. It may be noted that the receivership was instituted at a time of greatest business depression, during July last year, and has continued successfully even despite the adverse circumstances of receivership and the war abroad. The company has made a showing that has been regarded as remarkable. Judge Hazel congratulated the receivers and their attorneys upon the successful outcome of the case.

The large plant at Niagara Falls, N. Y., has been doing a larger volume of business during the present month than for a year past, and orders booked for future deliveries are considered satisfactory. With the future of the company now assured, there will be a larger increase of orders that have been pending for some time past on account of the uncertainty in connection with the destinies of the company, which are now happily settled and which will result in the continued employment of a large body of men.

As is usual in similar cases, the receivers will be authorized to sell the assets of the company, and, as stated before, the Stockholders' Reorganization Committee will purchase same for the benefit of creditors and the preferred and common stockholders whom they represent. The receivers of the company are James A. Roberts, of New York City, James O. Moore, of Buffalo, and J. Allan Smith, of Niagara Falls, N. Y.

A unique dinner was recently given in Toledo. Each guest cooked his own dinner by electricity.

Cedar-Producing and Shipping Facilities of the MacGillis & Gibbs Company.

In new construction of overhead lines, careful selection of poles for size and quality is essential for getting the longest life of the line. In the emergency reconstruction of such lines it is necessary to emphasize not only these points, but also speed in getting the material on the ground so that the rebuilding can proceed with a minimum of interruption. It was with these ideas that the cedar-pole business of the MacGillis & Gibbs Company, Milwaukee, Wis., was developed to its present high-class condition. The company produces both red cedar and white cedar products, including poles up to 60 feet in length, cross ties, fence posts, etc. The aim of the company throughout has been to give the best possible service; it has built up an excellent service organization for this purpose.

For over 15 years the company has produced northern white cedar on a large scale. It has found that shipments from wood's landings are generally unsatisfactory, green and improperly sorted timber being often the result of inadequate storage and handling facilities. Therefore no shipments are made direct from the woods. The company has concentrating yards located in the best white-cedar-producing districts, which are well located for securing proper shipment on short notice. In connection with the company's main office in the Wells Building, Milwaukee, there have been established branch offices at Minneapolis, Minn., and Chicago, Ill., these latter being for personally tracing any delayed shipments.

The largest yard of the company is located at Gladstone, Mich., which is a division point on the Soo Line Railroad, and therefore is an excellent distributing point, since it always has a large supply of cars on hand. This yard is located in the center of the Northern Michigan white-cedar-producing territory. This yard has been in service some 15 years, during which time it has been steadily increased in capacity and in facilities for proper sorting of the timber and rapid shipment. The present capacity is such that an average of about 1,000,000 pieces of white cedar are easily handled in the yard annually. An idea of the extent of the yard can be gained from the accompanying illustration. The view shows a long train bringing a mixed lot of poles from the woods. These poles are unloaded, carefully graded and sorted into piles so as to be ready for instant shipment. Six separate loading tracks give excellent facility for loading shipments rapidly. Since the stock has been piled in various groups, depending on size of pole and quality, and since the receiving of timber is so conducted as not to interfere with shipment, outgoing shipments can be handled with extraordinary speed.

Another yard of the company is located at Duluth, Minn., which is noted as a railroad and shipping center. Here a large stock of assorted poles and other timbers is kept on hand ready for immediate shipment on rush orders. Abundant cars are available, and shipment by water can also be done in season. At Remer, Minn., in the heart of the best white-cedar swamps of northern Minnesota, is another yard on the Soo Line. The company's red cedar yard is near Sand Point, Idaho.

Each of the yards is in charge of an experienced and reliable superintendent, who from long training is able to make proper selection of poles to meet requirements. In all of the yards the stock is kept until thoroughly seasoned, and no green timber is shipped.

Part of Main Yard at Gladstone, Mich., Showing Incoming Train of Poles and Assorted Piles.

Portion of MacGillis & Gibbs' Yard at Duluth, Minn., Showing Assorted Poles Ready for Shipment.

Utilities Get Portable Instruments to Aid in Improving Service Standards.

As an example of the hearty spirit of co-operation with which the operating companies are working with the public service commissions, the recent orders placed by a number of companies operating throughout Illinois, for measuring instruments are of interest.

These companies, in complying with the orders of the Illinois Public Utilities Commission, have ordered for use in regular portable service high-grade meters such as are used in standard laboratory work.

The Illinois Traction System has placed an order with the Westinghouse Electric & Manufacturing Company for 19 graphic voltmeters, 20 portable standard watt-hour meters, 19 portable voltmeters, together with a number of other miscellaneous portable meters.

The Southern Illinois Light & Power Company, Hillsboro, Ill., has ordered eight portable graphic voltmeters and two ammeters of the same type, four portable wattmeters, two portable voltmeters and ammeters, two portable current transformers, and two each of the switchboard type graphic voltmeters and voltmeters, together with other portable instruments of laboratory type.

Latest Approved Fittings

CONDUIT OUTLET PLATES.—William H. Colgan Company, West Newton, Mass.

Rex outlet boxes for straight electric outlets, for use in knob-and-tube work; catalog Nos. 314, 414.

Rex BX outlet plates with armored cable connectors, catalog Nos. 604, 614, combination and straight electric for old work. Catalog Nos. 804, 814, combination and straight electric for new work.

Listed March 25, 1915.

FUSES, Cartridge Inclosed.—Chelton Electric Company, 314 Armat Street, Philadelphia, Pa., submittor; manufactured by Killark Electric Manufacturing Company, St. Louis, Mo.

"Chelton Electric Co." cartridge inclosed fuses, 0-200 amperes, 250 volts.

Listed March 24, 1915.

FUSES. Cartridge Inclosed. — The Trumbull-Vanderpoel Electric Manufacturing Company, Bantam, Conn., submittor; manufactured by Killark Electric Manufacturing Company, St. Louis, Mo.

"Trumbull-Vanderpoel" cartridge inclosed fuses, 0-200 amperes, 250 volts.

Listed March 24, 1915.

HANGERS, Lamp and Fixture.—The Thompson Electric Company, 5606 Euclid Avenue, Cleveland, O.

Cutout hangers, 15 amperes, 600 volts, Skeleton, Medium Canopy and Deep Canopy models; two-part interlocking hangers, upper portion being stationary and connected to line wires, while lower part, carrying lamp, may be raised and lowered by pulleys and cords. Engaging of parts automatically secures mechanical and electrical connections without stress on cord, and may be released by raising lamp slightly with quick pull on cord.

Note: Care should be taken in installation to provide means to prevent fixture from accidental release and falling after release due to loosening of cord fastening.

Listed March 30, 1915.

MOLDING. — Pague Manufacturing Company, 226 North Jefferson Street, Chicago, Ill.

"Pagrip" metal molding.

Listed March 23, 1915.

PANELBOARDS. — The Wells Manufacturing Company, 1562 Wells Street, Chicago, Ill.

Panelboards shown by tests and examinations conducted by Underwriters' Laboratories to be in accordance with requirements of the National Board of Fire Underwriters have labels attached.

Listed March 22, 1915.

RECEPTACLES, Standard.—V. V. Fittings Company, 1910 North Sixth Street, Philadelphia.

The electrical fittings illustrated and described in this department have been approved by the Underwriters' Laboratories, Incorporated, following examination and tests conducted under standards of the National Electrical Code as recommended by the National Fire Protection Association.

Keyless, 660 watts, 250 volts. Conduit box, catalog No. 43.

Listed March 30, 1915.

RHEOSTATS.—Industrial Controller Company, Milwaukee, Wis.

Motor starters and speed regulators, ⅛ to 50 horsepower, 110, 250 and 500 volts. Bulletin Nos. 1100, 1125, 1135, 1140, 1145, 1150, 1155, 1160, 1165, 1300, 1310, 1320, 1325, 1330, 1335, 1340, 1430, 1435, 2100, 2105, 2125, 2130, 2135, 2140, 2145, 2310.

Listed March 22, 1915.

ROSETTES, Fuseless.—The Arrow Electric Company, 103 Hawthorne Street, Hartford, Conn.

Pagrip Metal Molding—Pague Manufacturing Company.

Arrow E, 3 amperes, 250 volts. Concealed, catalog Nos. 301, 302.

Listed March 29, 1915.

SHADEHOLDERS. — The Bryant Electric Company, Bridgeport, Conn.

Bryant or Perkins.

Uno shadeholders, catalog No. 511. These shadeholders are designed to thread over spiral socket shells as supplied on Bryant or Perkins sockets and receptacles.

Listed March 9, 1915.

SOCKETS, Standard. — Benjamin Electric Manufacturing Company, 120 South Sangamon Street, Chicago, Ill.

"Benjamin" porcelain shell, keyless. 660 watts, 600 volts, catalog Nos. 4411, 4421, 4423.

Listed March 24, 1915.

SOCKETS, Standard.—The Bryant Electric Company, Bridgeport, Conn.

Metal-shell "Bryant" or "Perkins."

Pull, 250 watts, 250 volts, catalog No. 4068.

Listed March 6, 1915.

SWITCH BOXES.—Frankel Light Company, 5016 Woodland Avenue, Cleveland, O.

Pressed-steel "Ohio" boxes in single units for use with flexible tubing. These boxes have removable sides and suitable fastenings for assembly in gangs.

Listed March 23, 1915.

SWITCHES, Pendent Snap.—General Electric Company, Schenectady.

"G. E." two-button type.

Single-pole, 3 amperes, 250 volts, 5 amperes, 125 volts, catalog Nos. GE558, GE559, GE562, GE565.

Listed March 31, 1915.

SWITCHES, Push-Button Flush.—Francis Keil and Son, 401 East 163rd Street, New York, N. Y.

Four-way, 10 amperes, 125 volts; 5 amperes, 250 volts; catalog No. 32504.

Listed March 23, 1915.

SWITCHES, Surface Snap. — Hart Manufacturing Company, Hartford, Conn.

"Diamond H" switches.

Series-parallel heater type, 10 amperes, 125 volts, 5 amperes, 250 volts, catalog Nos. 802, 8022, 20 amperes, 125 volts, 10 amperes, 250 volts, catalog Nos. 803, 8032.

Also above types with indicating dials or lock attachments, or both.

Listed March 19, 1915.

SWITCHES, Surface Snap. — Manhattan Electrical Supply Company, 17 Park Place, New York, N. Y.

Single-pole, catalog Nos. 5121-24 inclusive, 5141-44 inclusive.

Double-pole, catalog Nos. 5125-28 inclusive, 5145-48 inclusive.

Three-point, catalog Nos. 5129, 5130, 5149, 5150.

Four-point, catalog Nos. 5131, 5132, 5151, 5152.

Two-circuit, catalog Nos. 5133-36 ininclusive, 5157-60 inclusive.

Three-circuit, catalog Nos. 5137-40 inclusive, 5157-60 inclusive.

Listed March 18, 1915.

SWITCHES, Surface Snap. — The Trumbull Electric Manufacturing Company, Plainville, Conn.

Single-pole, 3 amperes, 250 volts, 5 amperes, 125 volts, catalog Nos. 300-03 inclusive, 310-13 inclusive; 400-03 inclusive, 410-13 inclusive; 5 amperes, 250 volts, 10 amperes, 125 volts, catalog Nos. 320-23 inclusive, 420-23 inclusive, 425-28 inclusive.

Double-pole, 5 amperes, 250 volts, catalog Nos. 340-43 inclusive, 440-43 inclusive; 10 amperes, 250 volts, catalog Nos. 350-53 inclusive, 450-53 inclusive, 455-58 inclusive, 7456.

Three-way, 1 ampere, 250 volts, 3 amperes, 125 volts, catalog Nos. 358-9, 458-9; 3 amperes, 250 volts, 5 amperes, 125 volts, catalog Nos. 360-1, 460-1; 5 amperes, 250 volts, 10 amperes, 125 volts, catalog Nos. 365-6, 465-6, 468-9.

Four-way, 3 amperes, 250 volts, 5 amperes, 125 volts, catalog Nos. 355-6, 475-6, 478-9.

Also the above types with lock attachment (catalog No. 398) and key.

Listed March 18, 1915.

Current Electrical News

ATLANTIC STATES.

CHICOPEE, MASS.—The municipal light plant is soon to install 10 inverted street arc lamps on ornamental iron standards, in the center of this city. W.

SALEM, MASS.—The Salem Electric Light Company, one of the properties under the management of C. H. Tenney & Company, Boston, is to increase its generating capacity, installing a new 6,250-kilowatt generator, four 750-horsepower boilers with Taylor stokers, and a new switchboard. The total expenditure will amount to about $750,000. The company is gradually undergrounding its wires in the central part of the city. W.

WILMINGTON, DEL.—The DuPont Company intends to construct a large addition to its office building in this city. The new section will extend a city block on Eleventh Street to Orange, and a distance of 171 feet on Orange Street. A large amount of electrical apparatus will be used.

HUNTINGTON, PA.—Trustees of the J. C. Blair Memorial Hospital have authorized the erection of a home for nurses, in accordance with the plans and specifications of Edward L. Tilton, a New York architect. The building, which will cost $30,000, will have the most modern electrical equipment.

LANCASTER, PA.—The citizens of this city have approved of a loan of $270,000, of which $125,000 will be used for a new boys' high school building and the remaining $145,000 will be spent for improvements to the waterworks and fire departments. The electrical installation in the school building will be complete.

DUBLIN, GA.—The city votes June 8 on issuing $50,000 bonds for light and water plant improvements, to cost $10,000, etc. Address mayor.

NORTH CENTRAL STATES.

HAMILTON, O.—Considerable additions on several streets to the present ornamental lighting system are virtually assured by the action taken recently by two of the commercial organizations of the city. The West Side Commercial Association has turned over to the city contracts providing for the installation and maintenance of 30 additional lights, and about an equal number will be installed on Main Street.

BLUFFTON, IND.—The county commissioners will install a private lighting plant for the county infirmary. Address county auditor.

ASHLAND, WIS.—The local electric light plant will be increased in capacity. It is understood that the building of a new 10,000-kilowatt hydroelectric plant and a 5,000-kilowatt steam turbine plant is contemplated. A duplicate transmission line from Ashland to the Range by way of Odanah is also under advisement.

HUSTISFORD, WIS.—The local electric light and power plant has been destroyed, the loss aggregating, it is said, about $35,000. The owners, Mr. F. Lindeman, of Oak Grove, and Mr. Rohrschneider, of Hustisford, will rebuild.

BRIGHTON, IOWA.—By a vote of 149 to 29, at a special election, the L. R. Sherrill Company, of Burlington, was granted a franchise for an electric lighting plant.

STOCKTON, MO.—W. A. Whinery, of Caplinger Mills, is considering a project for the installation of an electric light plant, supplying current to Caplinger Mills, Stockton, El Dorado Springs and Humansville.

GAYLORD, KANS.—Bonds to the amount of $7,000 have been voted for the construction of an electric light plant here. It is planned to build a transmission line to Portis and Downs. G. R. Stephenson, mayor.

SOUTH CENTRAL STATES.

ELIZABETHTOWN, KY. — The Greenup Electric Company has filed articles of incorporation, with a capital stock of $10,000. It is authorized to issue bonds to the amount of $30,000. The company is now operating electric plants at Stithton, Horse Cave, Mumfordville and Brandenburg, and is part owner of the electric plants at Edmonton and Burksville. The company is contemplating establishing plants at Sonora and West Point.

LOUISVILLE, KY.—The Louisville Bridge & Iron Company, with a plant in Louisville, has decided to change its equipment from direct to alternating current and has issued specifications calling for 25 motors, to represent a total of 350 horsepower. The company uses central-station power.

LOUISVILLE, KY.—The Grocers' Biscuit Company has closed a contract with the James Clark, Jr., Electric Company for 14 motors, with a total of 150 horsepower for its new plant just being completed to take the place of the plant destroyed last fall by fire. This is a supplementary order, the initial order having included equipment installed when a temporary plant was equipped immediately after the fire.

LOUISVILLE, KY.—Gamble Brothers, wood workers, specializing in poplar siding, with a plant at Highland Park, have contracted for a General Electric 250-kilowatt generator, which, with addition of 20 motors, will electrify the whole plant. The generator takes the place of an old one of smaller capacity. Ten old motors will be retained.

MANCHESTER, TENN.—The local electric light plant recently acquired by the Tennessee Valley Light and Power Company will be overhauled in the near future.

MOUNTAIN HOME, ARK.—K. V. Loba and Dillon Underhill have applied to the city council for a franchise for installing an electric light plant here. D.

PRAIRIE GROVE, ARK.—The Prairie Grove Electric Company has been organized, with a capital stock of $6,000, for the purpose of installing an electric light plant here. D.

ALTUS, OKLA.—It is understood that the electric light plant will be enlarged for the purpose of furnishing current to neighboring communities.

ARANSAS PASS, TEX.—The city council has under consideration plans for improving the electric light plant and water works system at a cost of $35,000. D.

BURKBURNETT, TEX.—The city council has closed a contract for the installation of an electric lighting system here. D.

HARROLD, TEX.—The Commercial Club is promoting the construction of an electric light and power plant here. D.

LOCKNEY, TEX.—The Malone Light and Ice Company of Plainview, Tex., which recently purchased the electric light plant here of the Lockney Electric Company, will enlarge and improve the plant. D.

LUBBOCK, TEX.—The Malone Light and Ice Company of Plainview, Tex., will install new machinery in the electric light plant here which it recently purchased from the Lubbock Light and Ice Company. D.

SPRINGTOWN, TEX.—The Fort Worth Power and Light Company plans to install an electric lighting system and an ice plant here. D.

THRALL, TEX.—The Texas Power and Light Company plans to build a high power transmission line to connect Taylor, Thrall, Rockdale and Cameron with its central station at Waco.

WESTERN STATES.

FT. BENTON RIVER, MONT.—J. R. Hobbins has purchased an electric light plant at Choteau and will build a 16-mile transmission line from the United States reclamation camp on Sun River project.

BUFFALO, WYO. — The Buffalo Manufacturing Company, of this place, has decided to spend about $25,000 this spring in improvements to its power plant. A dam site has been purchased in Clear Creek Canyon, and a dam will be constructed to store water for power purposes. The power plant will be moved up the stream about four miles. The water will be conveyed from the dam to the water wheel, a distance of about 9,000 feet.

COKEVILLE, WYO.—A site for the proposed power plant that is to be constructed in City Creek Canyon, to furnish light and power to this town, has been selected by Charles O'Conner and W. H. Dingboom. The location

decided upon is about three miles from the mouth of the canyon and about five miles from town. Address mayor or town clerk.

MOORCROFT, WYO.—The town council has called an election to be held the same time as the spring election, when local taxpayers will vote on the question of issuing bonds for the installation of an electric lighting system. Address town clerk.

LA JUNTA, COLO.—At a recent election it was voted to issue bonds to the amount of $75,000 to build a municipal electric light plant. Address Mayor John N. Lamb.

LORDSBURG, N. M.—W. F. Ritter has purchased the Lordsburg Water, Ice & Electric Company and plans to remodel the plant.

BOISE, IDAHO.—An ordinance has been passed by the city council providing for the issuance of bonds in the sum of $23,885.30, the proceeds to be used for the installation of ornamental arc lights in Improvement District No. 1, which is created by the ordinance.

DUCHESNE, UTAH. — The town trustees have granted a franchise to John Glenn, of Vernal, and Marcellous Pope and R. W. Kroupa, of Duchesne, for the erection and operation of an electric light plant at this place to serve the town. The proposed plant is to be erected in the town proper and its estimated cost is $10,000. According to the franchise, work must be started within three months.

GARLAND, UTAH.—Negotiations have been entered into between the Garland City Council and the Utah Power and Light Company, whereby Garland will have a lighting system second to none in any city of its population. The system will cost $3,000, it will consist of 20 2,000-candlepower arc lights to be placed on the street corners and to extend to the city limits. The system will be leased to the city for a term of years. The material has been ordered and work will begin immediately.

PLEASANT GROVE, UTAH.—As an indication to install its own power plant, the town has filed application on 10 second-feet of water, to be taken from Grove Creek, and utilized for power purposes. A pipe line 8,860 feet long will be used to convey the water to a power plant, where machinery will be installed to generate electricity with which to furnish lights and power to this town and vicinity. Address the town clerk.

ABERDEEN, WASH.—The Northwest Electric and Waterworks Company of Montesano has applied for a franchise here to construct a line for the transmission of electric current.

CHELAN, WASH.—The Great Northern Railroad Company has decided to build a temporary power plant here this spring for use in pumping water for irrigation.

SEATTLE, WASH.—In a recent communication to the Mayor and City Council, J. D. Ross, superintendent of lighting, City of Seattle, recommended that an addition to the Lake Union Steam Auxiliary be constructed, doubling the capacity of the steam plant and increasing the light and power load from 10,000 kilowatts to 20,000 kilowatts. Superintendent Ross states that, owing to the length of time which will necessarily ensue before the new masonry dam at Cedar Falls is made available and valuable for storage purposes, owing to the seepage which has caused a great deal of concern, a new means of generating additional power must be supplied. Should the council approve of Superintendent Ross' plan for constructing an additional unit to the Lake Union steam plant, a bond issue will be submitted to the voters.

NORTH YAKIMA, WASH.—The Board of County Commissioners, Yakima County, has been petitioned by the Pacific Power and Light Company for a 50-year franchise for extensions to its power lines in the Moxee Valley and near the Naches Power Station. The extensions to be made in the Moxee Valley will be utilized in serving farmers and small communities and the Naches extension will operate a pumping station which is being constructed for irrigation purposes.

BAKER, ORE.—Baker will vote July 14 on the issuance of $80,000 bonds to enlarge the municipal lighting plant.

BEND, ORE.—Reported the city council has passed an electric franchise ordinance over the veto of the mayor of Bend in favor of the Bend Flour Mill Company, here, for a private transmission line. It is unofficially reported the company intends making improvements and extensions to its existing lines necessitating the expenditure of thousands of dollars.

GRANTS PASS, ORE.—Articles of incorporation for the Hell Gate Canyon and Coquille Power Company, with headquarters here, were recently filed with Secretary of State at Salem. The capital stock is $1,000,000. Incorporators are: Geo. E. Sanders, Grants Pass; Geo. W. Sorenson, Grants Pass, and Wharton Plummer, of Chicago. The company plans providing current for the city of Grants Pass for power, light and irrigation purposes.

FRESNO, CAL.—Announcement has been made that the San Joaquin Light & Power Company is preparing to construct a new $75,000 hydroelectric power plant at Merced Falls. The project is to replace one disabled two years ago. The plant will have a capacity of 1,000 kilowatts. For distribution purposes the power line from Merced Falls to Merced will be raised from 30,000 to 60,000 volts. This plant will supply Merced County, mines of Mariposa County and gold dredgers working on the Merced Falls.

LOS ANGELES, CAL.—Plans are under way for the installation of 500 ornamental electroliers at Culver City, an industrial suburb of this city.

MARTINEZ, CAL.—The Pacific Gas and Electric Company has purchased a site on Ferry Street, upon which will be erected an office building to be used as headquarters for the Contra Costa district, over which D. C. Fay is manager.

MARTINEZ, CAL.—The Great Western Power Company is building a power line into the large refinery of the Shell Company for temporary service. It is rumored that the company will later install its own plant.

PLACERVILLE, CAL.—The Western States Gas and Electric Company is preparing to spend about $75,000 this summer in increasing the capacity of its American River power project. The plans call for the renewal of the bulkhead on the north side of the American River dam, the building of a 30 to 36-inch penstock to convey water from Four Bay to the lower end of the American River flume to the power house, making a fall of 575 feet, installing new machinery at the power house, etc.

SAN JOSE, CAL.—An election will be held on May 3 to submit the proposition of the formation of the Milpitas Highway Lighting District, as outlined in a petition to the Board of Supervisors.

SANTA ANA, CAL.—Residents of Buena Park have petitioned the Board of Supervisors for the formation of the Buena Park Lighting District.

PROPOSAL.

ELECTRICAL EQUIPMENT. — Sealed proposasl will be received at the office of the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until May 4, for furnishing 10,000 feet of double-conductor cable, Schedule 8179, for delivery at Navy Yard, Newport, R. I.; miscellaneous three-conductor cable, Schedule 8176, for delivery at Navy Yard, Philadelphia, Pa.; miscellaneous three-conductor cable, Schedule 8178, and miscellaneous telephone cable, Schedule 8179, both for delivery at Navy Yard, Norfork, Va.; 200 pounds uncut sheet mica, Schedule 8200, for delivery at Navy Yard, Newport, R. I.; six switchboard panels, Schedule 8198, for delivery at Navy Yard, Philadelphia, Pa.; three 50-kilowatt transformers, Schedule 8179, for delivery at Navy Yard, Norfolk, Va.; 7,500 feet lighting and power wire, Schedule 8185, for delivery at Navy Yard, Brooklyn, N. Y.

NEW PUBLICATIONS.

TERRESTRIAL MAGNETISM.—The annual report of the director of the Department of Terrestrial Magnetism, Carnegie Institution of Washington, for 1914, describes the new laboratory and summarizes the work of the year.

ELECTRODEPOSITION OF METALS.—The March issue of *Lewis Insitute Bulletin* is entitled "The Electrodeposition of Metals" and contains the papers by Carl Dittmar, Max G. Weber, and Charles H. Proctor which were presented at a meeting held at the Institute on the evening of February 11, 1915.

CANADIAN MINERALS.—The Canadian Department of Mines has issued a report on the "Non-Metallic Minerals used in the Canadian Manufacturing Industries" by Howells Fréchette; and "Peat, Lignite, and Coal," by B. F. Haanel. The latter considers the values of the fuels for the production of gas and power in the by-product-recovery producer. It is illustrated and comprises 261 pages.

METRIC EQUIVALENTS. — The Bureau of Standards is distributing a publication of particular interest and value to those engaged in foreign trade This is a 68-page pamphlet, entitled "Units of Weight and Measure—Definitions and Tables of Equivalents." Copies may be obtained free upon application to the Bureau of Standards, Washington, D. C. The tables of equivalents relate to the translation from metric units to the customary units and from customary to metric. Manufacturers are in many cases placing the metric equivalents of the ordinary units in their catalogs in order that the dimensions may be intelligible to buyers in countries using the metric system.

NEW INCORPORATIONS.

HAZARD, KY.—The Hazard Power Company, with $25,000 capital, has been incorporated here by L. L. Stone, Mrs. L. L. Stone and J. D. Francis. G.

HARTFORD, CONN.—The Hartford Clock Company has been incorporated with a capital stock of $15,000, to manufacture electric clocks. W.

CLEATON, KY.—The Central Telegraph and Electric Company, with $4,000, has begun business here. The incorporators include A. M. Creel, L. J. Mohon and W. M. Jack. G.

GREENVILLE, O.—The Greenville Electric Light and Power Company has filed amended articles of incorporation increasing its capital stock from $155,000 to $180,000. L.

BUFFALO, N. Y.—Bulletin Machine Company, Incorporated; to manufacture bulletin displaying machines. Capital, $10,000. Incorporators: Albert K. Davis, Conrad S. Culver and John M. Fanning.

CANTON, O.—The Dillon Electric Company has filed amended articles of incorporation increasing its capitalization from $10,000 to $25,000, the increase being intended to provide for betterments to the plant. L.

TRENTON, N. J.—The Peoples Service Electric Company has been organized to manufacture and deal in electrical machinery. Capital, $125,000. The incorporators are Claudius B. Lasell, Elmer W. Bogart and Orris M. Driscoll.

HAZARD, KY.—The Eastern Electrical Supply and Construction Company has been incorporated here with $2,000 capital. Stockholders include S. E. Parfit, A. M. Gross and T. F. Curtis. G.

BOSTON, MASS. — The Lewis-Shepard Company has been incorporated, with a capital stock of $50,000, for the handling of motors and machinery. The incorporators are: Arthur L. Lewis; Frederick J. Shepard, Jr., and W. Lloyd Allen.

BLANDINSVILLE, ILL.—The Economy Electric Light and Power Company has been incorporated with a capital stock of $20,000. The company is to furnish light and power by electricity or gas. The incorporators are G. L. Mallery, P. L. Barrett and C. A. Stevens.

GOSHEN, N. Y.—Orange County Public Service Corporation; to manufacture electricity for light, heat and power. Capital, $500. Incorporators: Ralph Polk Buell, Nayside, N. Y.; George L. Lewis, Whitestone, Long Island, N. Y., and Charles G. Stanton, Brooklyn, N. Y.

NEW YORK, N. Y.—Witherbee Storage Battery Company, Incorporated; to manufacture electrical goods, batteries, appliances for automobiles, etc. Captial, $10,000. Incorporators: Eldred E. Jacobsen and Charles J. Steierman, of Brooklyn, N. Y., and M. J. Hanlon, of Tompkinsville, N. Y.

ANACONDA, MONT.—Articles of incorporation have been filed for the Little Missouri Improvement and Development Company, with a capital stock of $150,000, by Frank K. Wilson, Thomas T. Lyon and A. L. Rankin, for the purpose of constructing electric light and power plants, telephone lines, waterworks, etc.

FINANCIAL NOTES.

The annual meeting of the General Electric Company will be held May 11.

Philadelphia Electric Company directors have re-elected officers.

The $8,000,000 Commonwealth Edison Company first-mortgage five-per-cent bonds, due 1943, purchased by a syndicate of eleven Chicago, New York and Boston banking houses, have all been sold. The public offering price was 100.

The Pacific Light and Power Company has sold to New York bankers $2,338,000 six-per-cent notes, the proceeds of which will be used to retire a like amount of collateral trust five-year six-per-cent bonds, due July 1, 1915. The bonds are secured by the deposit of $3,118,000 first-mortgage six-per-cent Southern California Gas Company bonds.

New alumina works are to be erected almost immediately at Burntisland by the British Aluminium Company and power plant for rolling mills at Warrington has been completed. Further plant is being installed for the extension of the manufacture of carbon electrodes at Kinlochleven. The company has, in the normal course of things, big business with German purchasers, and when the war broke out many such orders and contracts had to be canceled, but this was offset by the increased demand of the British and allied governments and contractors working for them, so that the trading profits for 1914, at $1,361,280, are somewhat better than for 1913. Prices are approximately the same, but there are difficulties in connection with supplies of raw material, and costs of production are higher, but output and sales are both better.

Dividends.

	Term.	Rate.	Payable.	
Automatic Elec.	Q	1%	May	1
Col. Ry. Pr. & Lt., B. pf.	Q	1.25%	May	1
Col Ry., Pr. & Lt., com.	Q	1.25%	May	1
Edison Elec. Illum., Boston	Q	3%	May	1
Elec. Bond & Share, pf.	Q	1.5%	May	1
Interboro Rap. Tran.	—	5%		
Keystone Tel., pf.	S-A	3%	May	1
Lehigh Val. Tran., pf.	S-A	1%	May	1
Louisville Gas & Elec., pf.	Q	1%	Apr.	30
Sierra-Pac. Elec., pf.	Q	$1.50	May	1

Report of Earnings.

EDISON ELECTRIC ILLUMINATING COMPANY OF BROOKLYN.

The Public Service Commission has issued a report covering the operations of the Edison Electric Illuminating Company of Brooklyn for the year ended December 31, 1914, which compares as follows:

	1914	1913
Operating revenue	$6,244,384	$5,655,200
Net after taxes	2,076,532	2,007,839
Other income	25,822	25,385
Total income	2,102,354	2,033,224
Charges	2,028,537	1,961,527
Surplus	73,817	71,697

PERSONAL MENTION.

MR. EMMET R. CURTIN has taken charge of the St. Mary's plant of the Indiana Lighting Company, succeeding Mr. Frank H. Cutshall.

MR. W. R. MULLIGAN, manager of the United Electric Light Company, Springfield, Mass., gave a talk before the newly organized Electric Club in that city April 14.

MR. F. THOMAS TURNER, until recently assistant sales manager of the Minneapolis General Electric Company, has taken up district sales work for the Beebe Sales Company, Minneapolis, manufacturer of the new Beebe washing machines.

MR. JOSEPH E. MONTAGUE, general manager of the Niagara Electric Light and Power Company, Niagara Falls, N. Y., was married on April 15, at Clifton Place, Niagara Falls, Ontario, Can., to Mrs. Sarah Cook Reeder.

MR. H. M. VAUGHAN has accepted the position of sales manager of the Automatic Electric Washer Company, of Newton, Iowa, taking the place of J. W. Winger, who resigned to become postmaster of Newton. Mr. Vaughan is thoroughly familiar with the selling end of the electrical business and has been identified with electrical interests for many years. He installed the first commercial electric light plant in Newton in 1886.

MR. F. W. BAKER, for the past two years general efficiency man and statistical compiler for the Cumberland County Power and Light Company, Portland, Me., has been appointed private secretary to General Manager A. H. Ford, succeeding Mr. Norman S. Alexander., who has been elected manager of the Fairmount Park Traction Company, Philadelphia, Pa. Before coming to Portland, Mr. Baker was with the Independence Inspection Bureau of Philadelphia.

MR. EDWARD A. DEEDS, of Dayton, O., for 15 years connected with the National Cash Register Company, starting as electrical engineer, has resigned his position as vice-president and assistant general manager of that company, for the purpose of devoting his entire attention to the business of the Dayton Engineering Laboratories Company, which he founded. The latter company's business started in a barn in the rear of Mr. Deeds' home, and grew to enormous proportions in a short time, "Delco" electrical automobile equipment now being used all over the world. The plant now employs 1,700 people. Mr. Deeds remains a director of the cash register company, but will devote all of his time to the other company, of which he is president.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

	Apr. 19.	Apr. 12.
American Tel. & Tel. (New York)	123⅛	120
Commonwealth Edison (Chicago)	136	—
Edison Electric Illuminating (Boston)	244	243
Electric Storage Battery common (Philadelphia)	50¼	50¼
Electric Storage Battery preferred (Philadelphia)	50¼	50¼
General Electric (New York)	154	149
Kings County Electric (New York)	119	119
Massachusetts Electric common (Boston)	—	—
Massachusetts Electric preferred (Boston)	43	44
National Carbon common (Chicago)	137	130
National Carbon preferred (Chicago)	119½	119¾
New England Telephone (Boston)	128¼	132
Philadelphia Electric (Philadelphia)	24¾	24
Postal Telegraph and Cables common (New York)	78½	76
Postal Telegraph and Cables preferred (New York)	68¼	67½
Western Union (New York)	67½	66
Westinghouse common (New York)	86	77⅛
Westinghouse preferred (New York)	120	120

OBITUARY.

MR. WILLIAM A. FOOTE, organizer and head of the Commonwealth Power Company of Michigan, which operated power stations throughout Michigan, and also was connected with similar plants in various other states, died at his home in Jackson, Mich., April 14. He was 65 years old.

MR. MAURICE AUGUSTUS VIELE, president of the Viele, Blackwell & Buck Company, died April 11. He was a son of Augustus Hamilton Viele and was one of the best known electrical engineers in New York City. He was also president and a director of the General Reduction, Gas and By-Products Company, and the General Utilities Company, and was a director of the Electric Operating Construction Company. Mr. Viele was a member of the St. Nicholas Club, where he lived; the Engineers Club, the American Society of Civil Engineers and the Spanish War Veterans.

MR. CHARLES I. HILLS, president of the Franklin Electric Company, Hartford, Conn., died at his home at Elizabeth, N. J., on April 15. Mr. Hills was 53 years of age. He had been ill for a year, and death was caused by a complication of diseases. He is survived by his widow and two sons. "Charlie" Hills, as he was familiarly known, was long a prominent figure in electrical circles. He attended practically every national convention of electrical men, and was a familiar figure in connection with many state organizations. He was a leading member of the Electrical Manufacturers' Club, and in connection with the meetings of the Electrical Supply Jobbers' Association for many years conducted the athletic tournaments and acted as master of transportation and commissary for the joint organizations. He was a pioneer manufacturer of incandescent lamps, and took a conspicuous part in the development of the business and in working out amicable and profitable trade relations between the various elements of the industry. He was gifted with a remarkable disposition, attracting friends by the score.

DATES AHEAD.

Arkansas Association of Public Utility Operators. Annual meeting, Little Rock, May 11-13. Secretary, W. J. Tharp, Little Rock, Ark.

Arkansas Association of Electrical Contractors. Annual meeting, Little Rock, May 12-13. Secretary, J. C. Dice, Little Rock, Ark.

Gas, Electric and Street Railway Association of Oklahoma. Fourth annual convention, Oklahoma City, May 12-14. Secretry, H. V. Bozell, Norman, Okla.

Southwestern Electrical and Gas Association. Eleventh annual convention, Galveston, Tex., May 19-22. Secretary, H. S. Cooper, 405 Slaughter Building, Dallas, Tex.

Missouri Public Utilities Association, Annual convention, Steamer *Quincy*, May 27-30. Secretary, F. D. Beardslee, 315 North Twelfth Street, St. Louis, Mo.

National District Heating Association. Annual convention, Hotel Sherman, Chicago, Ill., June 1-3. Secretary, D. L. Gaskill, Greenville, O.

National Electric Light Association. Annual convention, San Francisco, Cal., June 7-11. Secretary, T. C. Martin, 29 West Thirty-ninth Street, New York, N. Y.

National Electrical Contractors' Association of the United States. Fifteenth annual convention, San Francisco, Cal., July 21-24. Secretary, George H. Duffield, 41 Martin Building, Utica, N. Y.

With the Electrical Manufacturers

The General Insulate Company, Brooklyn, N. Y., has appointed A. F. Larrabee, 88 East Congress Street, Detroit, Mich., agent for its Michigan territory.

Hazard Manufacturing Company, Wilkes-Barre, Pa., has issued a new price list on steel wire ropes and strands designed especially for oil and gas-well lines.

Century Electric Company, St. Louis, Mo., has increased its capital stock (fully paid) to $1,000,000 in order to enable it to care more readily for the rapidly increasing demand for its single-phase motors and fans.

The Bristol Company, Waterbury, Conn., has moved its Pittsburgh branch office to larger quarters in the Frick Building. This office is in charge of R. B. Anthony, Pittsburgh district manager.

The Chicago Mica Company, Valparaiso, Ind., has opened a branch office at the Hodges Building, Detroit, Mich., in charge of A. W. Drew as sales agent. The company is the manufacturer of "Micabond," standard mica insulation, and other mica insulating materials.

The Hudson Wire Company, Ossining, N. Y., manufacturer of brass, copper bronze and German silver wire and resistance wire, has succeeded to the business of Royle and Akin, New York City. The president is Robert M. Akin, and the vice-president and general manager is Joseph Royle. The New York office is at 256 Broadway.

Central Telephone & Electric Company, St. Louis, Mo., has prepared some leaflets illustrating and describing the construction and uses of the company's Pract-el-lite. This is an ingenious hand lantern employing an ordinary dry cell and is made either with special container for the cell or so that it can be secured directly to the terminals of the cell.

Hotpoint Electric Heating Company, Ontario, Cal., is sending out another large circular calling the attention of dealers to the special sale of El Grilstovo and the permanent reduction in price of Hotpoint irons, taking effect during Hotpoint Week, May 3 to 8. National advertising is reproduced and material for special window displays offered to the trade.

Cooper Hewitt Electric Company, Hoboken, N. J., has issued bulletin No. 58, which is devoted to photography by Cooper Hewitt mercury-vapor lamps. Advantages of using these, particularly for portraiture, are set forth. The equipments best suited for different needs are described and illustrated. Many photographs made by the use of these lamps are reproduced.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has received an order from the Chicago & Milwaukee Electric Railroad Company for fifteen quadruple equipments of type No. 557-A, 140-horsepower motors with double-end type HLF control. These equipments are to be placed in high-speed passenger express service between Chicago and Milwaukee. The cars will be arranged for train operation.

The A-A Electric Manufacturing Company, 355 Water Street, Bridgeport, Conn., has purchased from the firm of **Harvey Hubbell, Incorporated,** of Bridgeport, the street and store fixture business formerly conducted as part of the Hubbell activities. The A-A company will maintain the same prices and policy in regard to these goods and will always keep a large stock on hand so that orders may be promptly and satisfactorily filled.

Pass & Seymour, Incoporated, Solvay, N. Y., has ready for distribution four new descriptive folders containing information that the wireman or electrical user of P. & S. devices will find valuable. One of these deals with conduit box straps, another with mogul-base sockets and receptacles, another with decorative material, and the fourth with the P. & S. candle socket; this last publication is especially well gotten up.

The Nuttall Company, Pittsburgh, Pa., announces that the sale of Nuttall gears, pinions and trolleys for electric railway, mining and industrial use in the Chicago territory has been transferred to the Chicago office of the Westinghouse Electric & Manufacturing Company, 39 South La Salle Street. The Chicago territory includes the southwestern part and upper peninsula of Michigan, northern halves of Indiana and Illinois, all of Wisconsin, Minnesota, North Dakota, South Dakota, Nebraska and Iowa.

Northwestern Electric Company, 611-615 West Adams Street, Chicago, Ill., is establishing a branch office in New York City. It will be in charge of E.

B. Edwards, who has long been connected with the company in Chicago. The New York branch will devote itself especially to the Martin rotary converter for use in motion-picture theaters and in garages for battery charging on the constant-potential system, also for any other purpose where direct current is necessary in an alternating-current district.

The Statistics Bureau, 5 East Forty-second Street, New York City, has ready a new catalog of materials for use in the graphic presentation of facts. These range from thumb tacks to racks and cabinets. These materials are invaluable for engineers, statisticians, accountants, executives, and all others who are called upon to present statistical data in graphic and effective manner.

Walker Brothers & Haviland, Chicago, Ill., will remove their offices from the Monadnock Block to 1821 Peoples Gas Building on May 1. The concern is the general sales representative for the Industrial Controller Company, formerly the Independent Electric Manufacturing Company, Milwaukee, Wis., manufacturer of a complete line of automatic and manually operated motor starters and rheostats. It is also the representative for the Monarch Synchronized Time System, which includes a complete line of electrically operated clocks, time stamps, employees' recorders, etc.

Moloney Electric Company, St. Louis, Mo., has issued catalog No. 150, which is a very attractive publication with a large number of views of the standard and special types of Moloney transformers, many of these showing detailed views of the internal construction, terminals, methods of testing, etc. Among the transformers described and illustrated are type H. E. distributing transformers, type C single-phase and three-phase transformers for outdoor service, type E water-cooled transformers, subway transformers, current, potential and special testing transformers, sign transformers, etc. Chapters of the publication deal with the low core and copper losses which permit the attainment of high efficiency, aging of the core, insulation of the coils, etc.

Fort Wayne Electric Works of General Eectric Company, Fort Wayne, Ind., has issued bulletin Nos. 46,100 and 46,101, dealing with types M and P maximum demand indicators. The former, known also as the Maxicator, has, as an auxiliary to the four regular watt-hour meter recording dials, a pointer to show the maximum demand in any predetermined interval during a weekly, monthly or other period. The type P instrument, known also as the Printometer, is for use with a watt-hour meter, and prints at regular intervals, 15 or 30 minutes or the like, the time and total dial reading; from this printed tape record the demand at each hour of the day, or fraction thereof, can be quickly determined, also the maximum demand for the month, week or other period. Each bulletin describes and illustrates the instruments in detail, also the auxiliary contactors and relays. The Fort Wayne Works has also ready a new bulletin index of active publications.

Spray Engineering Company, 93 Federal Street, Boston, Mass., announces that Lee H. Parker has become its president. Mr. Parker has had a very wide experience in the engineering field. For a number of years he was associated with the General Electric Company and for the past ten years with the Stone & Webster Engineering Corporation. For several years he also represented large London interests in South America. He therefore brings to the company extended engineering and executive experience which will be utilized in developing the company along sound engineering and commercial lines. The company acts as engineer in the design of spray cooling ponds, irrigation systems, aerating reservoirs, odor condensers and gas washers. It manufactures air washers, spray nozzles, aerating nozzles, asphalt nozzles and park sprinklers. The company has just issued two new bulletins, Nos. 101 and 151. "Sprays for Cooling Condensing Water" describes and illustrates spray cooling ponds for power plants, textile and other industrial mills, ice-making plants, etc. The company's efficient spray nozzle is described in detail and its value in making spray ponds an economical means for cooling water is set forth. "Washing and Cooling Air for Steam-turbine Generators" sets forth the many advantages of thus treating the ventilating air for large turbogenerators. An illustrated description of air-washer equipments for this purpose is given.

Record of Electrical Patents.

Issued by the United States Patent Office, April 13, 1915.

1,134,986. Adjusting Device for the Note-Sheets of Self-Playing Musical Instruments. E. G. Anderson, Cranford, N. J. Electromagnetically controlled.

1,134,995. Electrical Heater. F. J. Cook, assignor to Konsrv Electric Co., Cleveland, O. For use in vehicle to warm feet of driver.

1,134,996. Annunciator Drop. S. H. Couch, W. W. Henry and A. E. Stevens, assignors to S. H. Couch Co., Atlantic, Mass. Drag on the indicator to prevent rebound.

1,135,000. Paper-Thickness Regulator. O. M. Donaldson, West Allis, Wis., assignor of one-half to B. F. Peisch. Paper-making machine with gauge electrically controlling speed of driving motor.

1,135,010. Cartridge Fuse. W. T. Garlitz and W. R. Gardner, McKees Rocks, Pa. Special means for clamping element to end caps.

1,135,011. Telephone System and Apparatus. C. L. Goodrum, assignor to Western Electric Co. Automatic telephone system with special control of switch wipers.

1,135,014. Position-Indicator for Elevators. G. Harding, Spokane, Wash. Reduction mechanism moves rheostat contact and index of galvanometer.

1,135,016. Magnetic Separator. J. L. Hiller, Mattapoisett, Mass. Conveyor delivers material to be separated directly onto poles of electromagnet.

1,135,019 and 1,135,020. Shade-Holder. H. Hubbell, Bridgeport, Conn. Has contractile shade-gripping ring with loops in slotted flange of body and ends operated by right and left-threaded screw. (See cut.)

1,135,040. Electric Signaling Apparatus. E. G. Missbach, assignor to Siemens & Halske Aktiengesellschaft, Berlin, Germany. Has corresponding sending and receiving elements for greater and smaller units.

1,135,048. Warning Signal. A. N. Pierman, Newark, N. J. Compressible bulb actuates switch.

1,135,049. Electric-Lantern Attachment. N. S. Richmond, Chicago, Ill. Lamp socket, switch and reflector mounted directly on dry-cell terminals.

1,135,069. Electric-Socket Cover and Shade-Holder. G. A. Spurway, assignor to Steele & Johnson Mfg. Co., Waterbury, Conn. Separable cap and body and connection between them.

1,135,087. Oil-Guard for Dynamo-Electric Machines. J. E. Webster, assignor to Westinghouse Electric & Mfg. Co. Stationary guard with annular groove for railway motor.

1,135,093. Electric Motor. W. Barnes, Jr., assignor to Westinghouse Electric & Mfg. Co. Double-trunnion construction for fan motor.

1,135,101. Egg-Tester. S. A. Eberle, Cincinnati, O. Electric light in casing.

1,135,103. Cooling System for Transformers. C. Le G. Forescue, assignor to Westinghouse Electric & Mfg. Co. Provides active circulation of oil through cooling coil.

No. 1,135,020.—Shade-Holder.

1,135,121. Telephone Exchange. F. A. Lundquist, assignor to Western Electric Co. Automatic telephone system.

1,135,129. Arc Lamp. H. E. Moul, assignor to Westinghouse Electric & Mfg. Co. Special feed and start for converging electrodes.

1,135,130. Protective Switch Box. T. E. Murray, New York, N. Y. Has fuse and switch compartments, opening of lid over former opening also switch.

1,135,138. Snap-Switch Base. W. H. Pratt, assignor to Arrow Electric Co., Hartford, Conn. Has special lock plate.

1,135,154. Process of Removing Carbon From Pressed Bodies of Tungsten. F. Blau, assignor to General Electric Co. Consists in heating in an atmosphere of hydrogen and ammonia and in removing the carbon in unoxidized gaseous form by the agency of the nitrogen in the atmosphere.

1,135,193. Cap for Lamp Sockets and the Like. Charles J. Klein, assignor to Cutler-Hammer Mfg. Co., Milwaukee, Wis. Contains heavy insulating lining.

1,135,194. Insulating Means for Lamp Sockets and the Like. C. J. Klein, assignor to Cutler-Hammer Mfg. Co. Insulating cap.

1,135,195. Device for Preheating Hydrocarbons in Carbureters. R. E. Krause, assignor to Krause Mfg. Co., Detroit, Mich. Electric heater.

1,135,199. Electric Switch. A. E. J. Maage, assignor to Cutler-Hammer Mfg. Co. Relates to mechanism of pull socket.

1,135,201. Magnetic Switch. J. F. McElroy, Albany, N. Y., assignor to Consolidated Car Heating Co. Trap release for reciprocating contact arms.

1,135,206. Plug-and-Socket Connector. J. Sachs, assignor to Hart & Hegeman Mfg. Co., Hartford, Conn. Separable attachment plug.

1,135,207. Attachment for Incandescent-Lamp Sockets. J. Sachs and C. A. Francis, assignors to Hart & Hegeman Mfg. Co. Lateral shade with neck clamped to socket.

1,135,225. Railway Block System. R. E. Thompson, New York, N. Y., assignor of one-half to A. V. Beer. Operated by pulsating current.

1,135,285. Circuit-Controller. F. R. Hoyt, assignor to A. E. Eickhoff, Indianapolis, Ind. Regulator for governing connection of generator and battery to circuit.

1,135,308. Illuminated Sign. C. A. McNeal, Columbus, O. Lamps connected to contact banks and individually operated by means of contact bars.

1,135,311. Automatic Switch for Controlling Lights. L. A. Meyers, Sauk Center, Minn. Switch controlled by position of door.

1,135,321. Selective Electrical Signaling. L. M. Potts, assignor to A. McLanahan, Baltimore, Md. Includes interconnected sets of relays.

1,135,322. Transmitting Apparatus for Electrical Signaling. L. M. Potts, assignor to A. McLanahan. Power-driven telegraph transmitter.

1,135,327. Dynamo-Electric Machine. M. A. Savage, assignor to General Electric Co. Rotor core is hollow and has an axial pipe

bringing cooling fluid into cavity and a discharge opening about the pipe.

1,135,358. Cutout Box. R. C. Cole, assignor to Johns-Pratt Co., Hartford, Conn. Opening of window in the cover opposite the fuses opens switch.

1,135,374. Mechanism for Train-Control Systems. G. B. Gray, assignor to Automatic Train Control & Signal Co., Pittsburgh, Pa. Polarity-reversing device.

1,135,376. Union for Connecting Electric Cables to Subway or Junction Boxes. D. C. Hooker, assignor to Johns-Pratt Co. Cable bell.

1,135,384. Circuit-Controlling Apparatus for Train-Lighting Systems. E. H. M. Langley and E. W. Price, assignors to Electric & Ordnance Accessories Co., Ltd., Birmingham, England. Employs train-driven dynamo, two sets of storage batteries, a battery change-over switch and a single solenoid main switch.

1,135,389. Magnetic Flatiron. J. W. Moore, Fort Edward, N. Y. Electric heating coils and electromagnet are independently supplied.

1,135,393. Transmitter for Writing Telegraphs and the Like. A. Rappenecker, Bremen, Germany. Includes pencil lever, a resistance varied by its movements in the direction of abscissas, and a second resistance varied by movements in the direction of ordinates.

1,135,412. Control Apparatus. N. W. Storer, assignor to Westinghouse Electric & Mfg. Co. Liquid rheostat.

1,135,416. Controller for Power-Operated Mechanism. S. T. Walkup, New York, N. Y. For web-feeding mechanism of printing press; electrically controlled means to prevent choking up of press when paper web breaks.

1,135,427. Signaling System. C. E. Beach, assignor to G. O. Knapp, New York, N. Y. Transmitting and receiving loops normally in series but may be connected in multiple.

1,135,436. Telephonograph. E. Chabeault, Marseille, France. Listening device consists of a box with a series of partitions and automatic means for setting the partitions in vibration independently.

1,135,438. Electrical Relay. A. W. Copley, assignor to Westinghouse Electric & Mfg. Co. For regulator.

1,135,452. Machine for Interpreting Code-Messages. E. H. Hebern, assignor to H. & H. Patent-Developing Co., Oakland, Cal. Circuits are closed by passage of perforated sheets between a roller and steel balls.

1,135,468. Cable-Reeling Mechanism. F. L. Sessions, assignor to Jeffrey Mfg. Co., Columbus, O. For electric locomotive.

1,135,473. Cooking Apparatus. F. A. Vath, Chicago, Ill. Heat-insulated cooker with electric lamps as heating elements.

1,135,487. Signaling System. E. E. Backus, Chicago, Ill., assignor to Hall Switch & Signal Co. Has a selector at the central station for each line.

1,135,494. End-Cell Regulator. W. L. Bliss, Brooklyn, N. Y., assignor to Central Trust Co. of New York. Automatically varies number of storage-battery cells in circuit.

1,135,499. Storage-Battery Plate. A. L. Chamberlin, Des Moines, Iowa. Has two grids with a series of porous nonconducting plates within the grids and active material between the grids and porous plates.

1,135,523. Electric-Light Attachment for Bedsteads. C. W. Henderson, assignor to Henderson Specialty Mfg. Co., Ltd., Montreal, Que., Canada. W-shaped socket-supporting wire frame. (See cut.)

1,135,539. Electric Seam-Welding Apparatus. R. Mack, assignor to Thomson Electric Welding Co., Lynn, Mass. The electrodes make a wiping contact with the pipe and nonconducting rollers apply pressure between the electrodes.

1,135,541. Glow-Lamp Fixture. T. E. Murray and G. K. Jessup, New York, N. Y.; said Jessup assignor to said Murray. Key-switch mechanism for lamp socket.

1,135,548. Fuse Device. E. O. Schweitzer and N. J. Conrad, assignors to Schweitzer & Conrad, Chicago, Ill. High-tension fuse with spring to break apart fuse on melting and means for projecting a stream of chemical into the arc.

1,135,557. Train Control and Signal System. J. T. Thompson, assignor to Thompson Automatic Signal Co., Chicago, Ill. Electromagnetic air-brake-valve release.

1,135,574 and 1,135,575. Block-Signal Control Safety Appliance for Locomotives. G. W. Gerlach, Cumberland, Iowa. Electrically controlled engineer's valve.

1,135,580. Battery Connector and Receptacle. C. H. Harris, Keokuk, Iowa. Has adjoining compartments for each cell.

1,135,596. Double Gear for Controlling Electrically and by Hand Devices Placed at a Distance. V. Locarni, Cornigliano Ligure, Italy. Double-acting motor-driven steering gear.

1,135,600. Warning-Signal Device. R. H. Manson, assignor to Garford Mfg. Co., Elyria, O. Motor-driven diaphragm for automobile horn.

1,135,604. Process and Apparatus for Determining the Position of Radiotelegraphic Receivers. A. Meissner, Berlin, Germany. Comprises a rotating sender, a central undirected antenna and a number of directive antennas arranged in a circle about it for sending first a nondirective signal and then a rotating directive signal and means for determining at the receiving station the plane of the latter signal.

1,135,605. Means for Controlling the Illumination of Vehicles. W. S. Menden, Brooklyn, N. Y., assignor to Megoin Co. Two sets of lamps operated in different zones from the trolley wire and from a storage battery.

1,135,608. Current-Controlling Device. H. N. Ott, assignor to Spencer Lens Co., Buffalo, N. Y. Rheostat.

1,135,613. System of Operating Typewriters and the Like. L. M. Potts, assignor to A. McLanahan, Baltimore, Md. Telegraph typewriter receiving system.

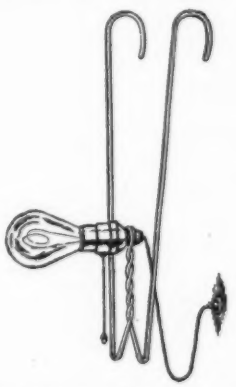
1,135,614. Telegraphy. L. M. Potts, assignor to A. McLanahan. Has motor-driven transmitting and receiving sunflowers at each station.

1,135,624. Electrical Telescopy. B. Rosing, St. Petersburg, Russia. Electrically operated revolving sets of mirrors and oscillographs.

1,135,643. Party-Line Telephone System. B. D. Willis, assignor to First Trust & Savings Bank, Chicago, Ill. Automatic means for disconnecting all substations from ground when taking down any of the telephones.

1,135,651. Smoke-Indicator. I. J. Babcock, Chicago, Ill. Includes electric lamp, lens and reflector.

1,135,652. Cracking-Off Machine. F. W. Bartlett, Caldwell Borough, N. J. Electrically heated wire for cutting glass cylinders.



No. 1,135,523.—Bedstead Lamp Support.

1,135,654. Intercommunicating Trunk-Line Telephone System. R. M. Beard, New York, N. Y. Interconnection of local stations and groups thereof.

1,135,656. Dynamo-Electric Machine. B. A. Behrend, assignor to Allis-Chalmers Mfg. Co. Arrangement of machine housing and rotor fan for ventilation.

1,135,660. Plating Barrel. F. S. Chase and J. H. Graham, assignors to Standard Co., Torrington, Conn. Electroplating tank with special anode support.

1,135,661. Condensing Apparatus. E. W. Christie, assignor to Wheeler Condenser & Engineering Co., Carteret, N. J. Has float-controlled alarm.

1,135,663. Electric Lighting. W. W. Coblentz, Poland, O. Manufacture of glowers for incandescent lamps; consists in attaching terminals of sodium-aluminum silicate to a rod of aluminum oxide and passing an electric discharge between them.

1,135,670. Safety Stop Apparatus for Railways. I. Czavra, Brooklyn, N. Y. Includes subdivided and insulated third rail.

1,135,686. Thermotelephone. B. Gwózdz, Schlachtensee, near Berlin, Germany. Wollaston wire traverses the aperature in a frame-like cast.

1,135,687. Thermic Telephone. B. Gwózdz. Amplification of above.

1,135,699. Adjustable Fixture Stud and Support. A. M. Knauber, assignor to M. Knauber, Oak Park, Ill. A section of pipe screw-threaded outside, diametrically opposed portions of the pipe being partially severed and bent outward.

1,135,714. Block-Refinisher. F. J. Pavelske and F. F. Malodzik, Cudahy, Wis. Motor-driven tool mounted on adjoining table so as to be capable of traveling over block.

1,135,717. Ground Clamp. W. H. Price, Moores, Pa. For clamping ground wire to conduit.

1,135,727. Spark Plug. A. Schmidt, assignor to Champion Ignition Co., Flint, Mich. Method of uniting metallic bushings and insulator.

1,135,798. Electric Rain-Alarm. H. J. Hirschmann, St. Louis, Mo. A strip of paper under a funnel is torn when saturated, allowing circuit to close.

1,135,801. Centrifugal Cutout. L. W. Horting, Lancaster, Pa., assignor of one-third to C. F. Stauffer and one-third to B. G. Stauffer. Centrifugal starting switch for motor.

1,135,822. Illuminating Device for License-Plates. G. Laub, Cleveland, O. Open-bottom casing about lamp with reflector throws light on number plate.

1,135,837. Egg-Tester. H. Niehoff, Bayonne, N. J. A box with an opening forming an egg-seat, a lamp under the seat and a dry cell and egg-depressed circuit-closer.

1,135,839. Time Switch. H. C. Nutting, Oelwein, Iowa. Arranged to control a number of circuits.

1,135,862. Insulated Rail-Joint. W. P. Thomson, assignor to Rail Joint Co., New York, N. Y. Has an insulating plate of transverse crescent form.

1,135,870. Motor Starter. G. H. Whittingham, assignor to Monitor Mfg. Co. of Baltimore City, Baltimore, Md. Controller with electromagnetic switches.

1,135,887. Call-Registering Device for Telephones. E. Ferran and F. D. Tweeddale, San Francisco, Cal. Coin-box mechanism.

1,135,894. Branch Box. M. Havens, Jr., Albany, N. Y. Cover consists of double plate with alined bushings.

1,135,898. Magneto-Electrical Generator. A. L. Heizer, Anderson, Ind., assignor to Vesta Accumulator Co. Frame construction.

1,135,916. Fire-Alarm. J. H. Owen, Newburgh, N. Y. Fusible circuit-closer.

1,135,920. Selective Electrical Signaling. L. M. Potts, assignor to A. McLanahan, Baltimore, Md. Special selecting relays for telegraph system.

1,135,926. Push-Button. G. E. Roedding and E. R. Roedding, Detroit, Mich. Radially actuated.

1,135,940. Lightning-Rod Cable. P. J. Juel, assignor to H. S. Rottenborg, Atlantic, Iowa, and H. C. Hansen, Brayton, Iowa. A central strand and several crossed superposed layers of wires.

1,135,971. Telephone-Call Recorder. D. J. McGauran, Geraldton, Western Australia, Australia. Operated by the subscriber's switch.

Reissue 13,901. Automatic Telephone System. F. Newforth, Jr., assignor to Automatic Electric Co., Chicago, Ill. Original No. 1,078,690, dated Nov. 18, 1913. Includes a back-bridge relay for the connector switch.

Patents Expired.

The following United States electrical patents expired on April 19, 1915:

602,429. Valve Controller. A. E. Colgate, New York, N. Y.

602,434. Signaling Device for Railway Cars. F. W. Diehl, Detroit, Mich.

602,463. Trolley-Wire Hanger. W. A. McCallum, Cincinnati, O.

602,495. Electric Contact Shoe. W. M. Brown, Johnstown, Pa.

602,527. Electrical Measuring Instrument. H. W. Sullivan, London, England.

602,548. Electric Controller for Gas Regulators. W. E. H. Williams and P. Seiler, San Francisco, Cal.

602,557. Alternate-Current Meter. C. P. Feldmann, Cologne, Germany.

602,564. Insulated Pipe-Coupling. G. Peeples, Philadelphia, Pa.

602,584. Electric Railway. H. W. Libby, Boston, Mass.

602,596. Electrical Apparatus. H. H. Eldred, Brooklyn, N. Y.

602,616. Invertible Fluid Battery. P. R. Cunningham and C. H. Howland-Sherman, Washington, D. C.

602,667. Railway Switch-Operating Mechanism. C. W. Squires, Springfield, Mass.

602,678. Traveling Contact for Underground Electrical Railways. G. B. Coleman and J. W. Duggan, Washington, D. C.

602,709. Apparatus for Reducing Electric Currents and Voltage. A. F. Vetter, Long Island City, N. Y.

602,746. Street Indicator. E. J. Hall, St. Louis, Mo.

602,747. Process of Smelting Phosphorus. C. K. Harding, Chicago, Ill.

602,767. Electric Switch. A. G. McPherson, Highland Park, Ill.

602,774. Electric Muscular Exerciser. E. Sandow, London, England.

602,815. Electric Furnace. G. G. Clark, Galveston, Tex.